Engineering News-Record

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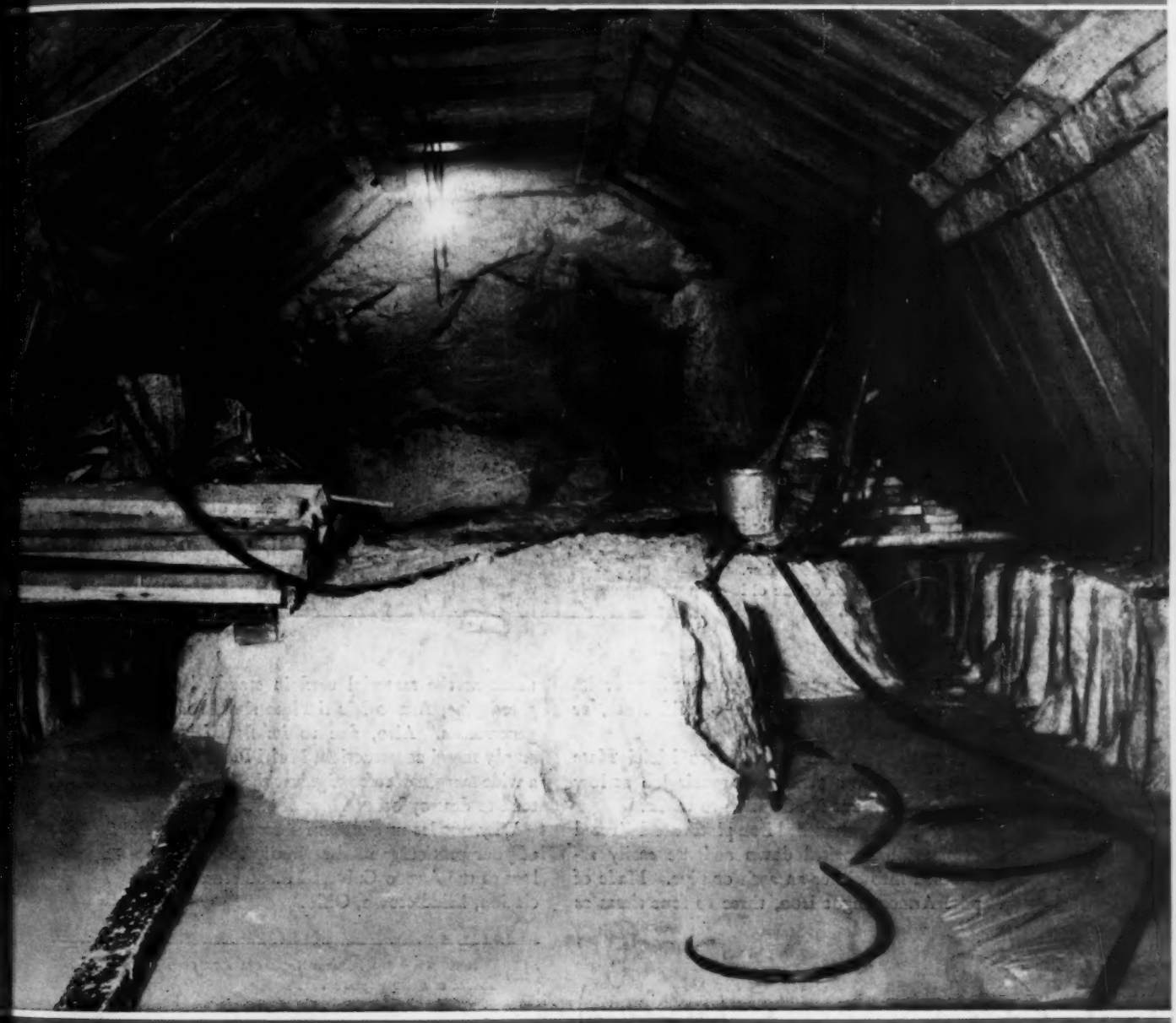


Sandstone in a Minneapolis - St. Paul sewer tunnel being pulverized by air chisels. Mixed with water it is then pumped to a disposal dump

Michigan Tertiary Road Laws

Rip Van Winkle Bridge Over the Hudson

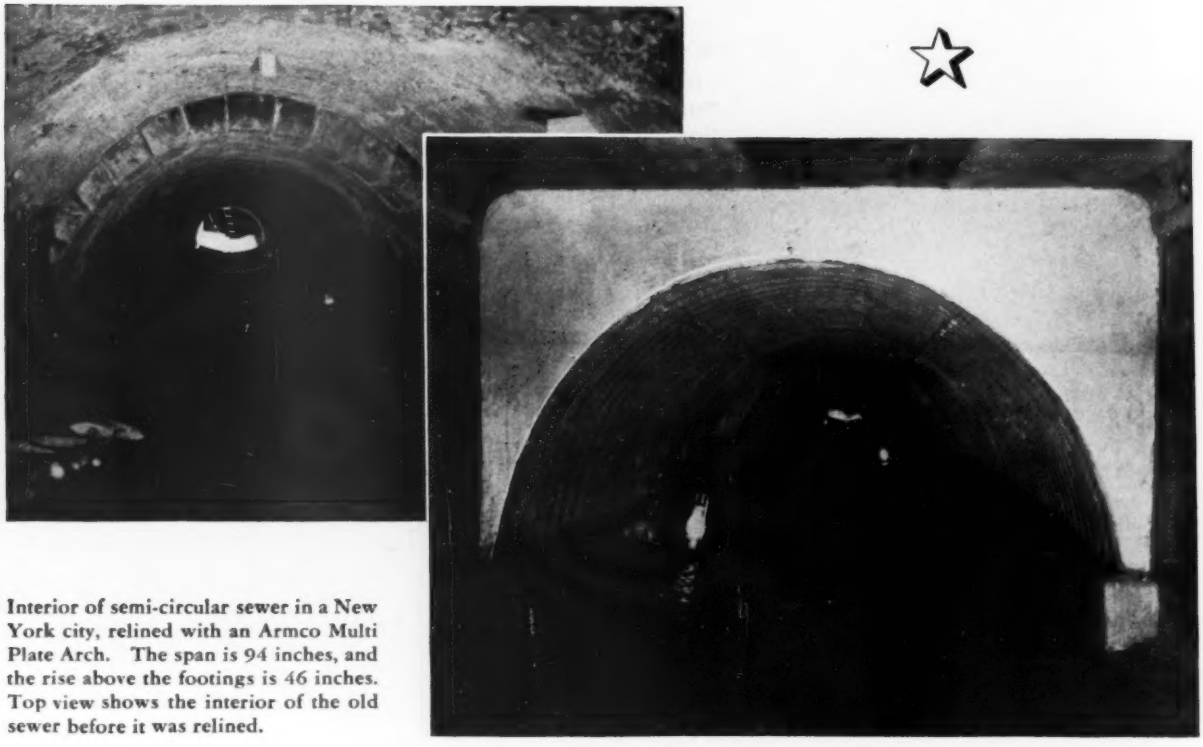
Pickwick Landing Dam of the TVA

Stevens' Recollections of the New Haven

Hydraulic Mining on Twin-Cities Sewer Tunnels

AS GOOD AS NEW

without the expense of completely rebuilding



Interior of semi-circular sewer in a New York city, relined with an Armco Multi Plate Arch. The span is 94 inches, and the rise above the footings is 46 inches. Top view shows the interior of the old sewer before it was relined.

WHAT will you do when your large storm sewers begin to fail—rebuild them, or reline them?

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For a PUBLIC WORKS POLICY

DURING the last five years engineers and constructors have been so fully absorbed in a fight for survival that they have had scant leisure to consider their long term interests. Thus they have permitted public works, always a major concern of theirs, to slip almost into the status of an expedient for the relief of distress.

This preoccupation with expediency has been excusable. Each expedient has more or less served its purpose; each must be judged by the conditions that gave it birth. On the whole, the public works policies advocated by the construction industry have been sound, constructive and in the public interest.

But the perversion of those policies in practice has created conditions that are good for no one—least of all the construction industry. And although we must continue to deal with the day's problems as they arise, the time has come for us to devote some of our thought and effort to the formulation of sound long term policies.

For it is evident that the federal work-relief structure is tottering. Even now those responsible for it are groping for an out that will reconcile the fiscal and political vicissitudes of the administration.

WHAT, then, may happen to the regular public works activities that have been absorbed into the relief effort? To be sure, municipal credit is improving and private construction shows a heartening rise in line with the trend of industrial recovery. But even in good times many engineers, constructors and producers must rely on the regular public works program. Will the reaction from the waste of CWA and WPA strike also at those well-considered and desirable public facilities that are so essential to private enterprise as well as community life? It should not, and if an aroused profession and industry will make itself heard and felt, it will not.

On no account should this matter be left to the mercies of politicians, bent only on making political capital, of plausible agents for special interests that, for their own good reasons, are hostile to certain types of public facility, or of their unwitting but effective allies, the professional calamity-howlers whose sole notion of citizenship is to rant about taxes and "tax-eaters" without regard for merit or reason. If such voices should prevail, public works for the public welfare would have short shrift.

No reasonable man will deny that industrial recovery demands a respite from wasteful and extravagant public spending. Unfortunately the public mind has been so confused by the authority given to the "spending agencies" over the normal process of investment in useful public works, that unless those responsible for the latter are on their guard these vital functions may be set back for years to come.

It is time for them to lay down some basic public works policies, both to meet present conditions and for the long term. How shall useful works be kept apart from job-making projects? Should federal aid to various types of state, county and municipal works be continued? If so, on what basis? By what standards shall we gage the economic soundness of a public enterprise, taking into account the indirect and long-term values that would not enter into the calculations of a private business? To what degree should consideration for one type of existing private enterprise hold back public improvements that would make possible another type of greater volume and wider utility? How can we insure that public construction will make the most effective use of private facilities and employ free labor at regular compensation rather than foster socialization in the name of relief or what-not?

THESE questions and many more must be answered before we shall have a sound public works policy. All of them have been forgotten in our frantic efforts to convert a vital and basic function of community life into a happy hunting ground for social workers.

And if they are to be answered fairly, honestly and in the public interest, they must have full consideration by those who know most about the public needs and who are least likely to be led into destructive excesses by the guardians of special interest or the clamor of short-sighted agitators.

Willard Chevalier

ENGINEERING NEWS-RECORD

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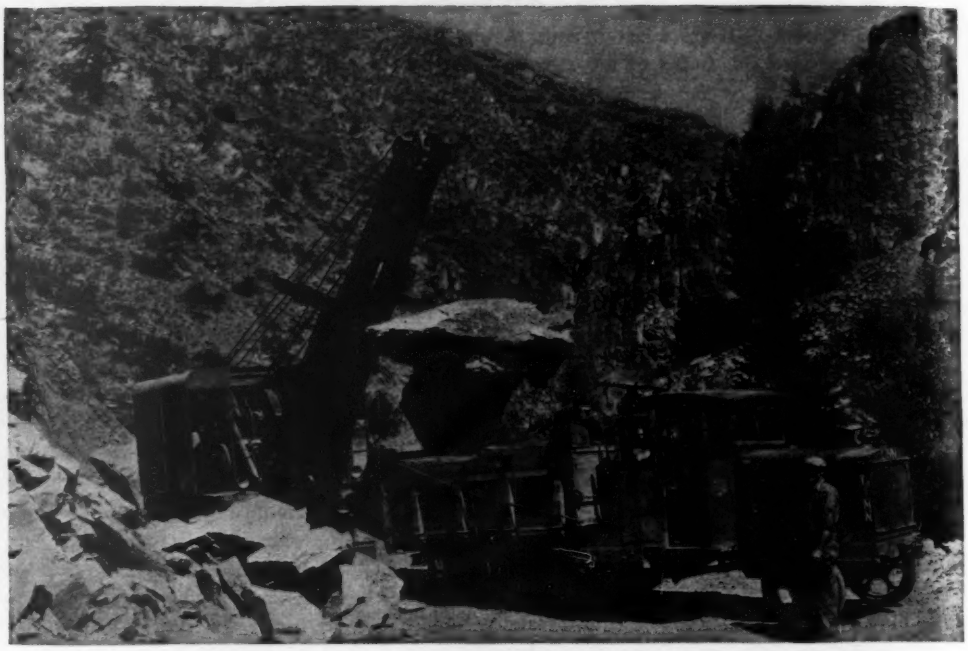
When conditions tie-up other equipment

. . . LINN CARRIES ON



LINNS working on the Orondo-Pine Canyon Road, Douglas Co., Washington . . . Lidral Construction Company.

Here's another case where LINN haulage carried on and made money every day . . . even on days when heavy rains kept other haulage equipment idle. "We use LINNS under many conditions," writes Mr. J. F. Lidral, "even during the wet weather when use of other equipment is impossible. And we use them in sand and in places where it would be necessary to lay planking for other equipment. Even under extremely dry conditions they perform equally well. The body size makes it easy to handle large rocks and their sturdiness enables them to withstand a lot of necessary abuse. And upkeep costs are favorable with those of other equipment." Mr. Lidral emphasizes many of the advantages of LINN haulage. But there are others, too, which will help cut costs and increase profits on every job. Let us send all the facts.

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V. T. Boughton
W. G. Bowman
Chicago
W. W. De Berard

McGraw-Hill Publishing Co., Inc. Editorial and Publishing Offices: 330 West 42d St., New York

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In the News:

UNDERPINNING of the old Sixth Ave. Elevated in New York during construction of the new subway may be avoided if plans under study now for early demolition of the Elevated should be adopted. The first subway contract was let several weeks ago, with underpinning required.

SLIGHT EARTH SHOCKS along the Eastern seaboard last week, with greatest disturbance in the province of Quebec, received a big play in the newspapers, which was natural. The harrowing experiences of Helena, Mont., which has suffered more than 700 shocks in three weeks, are as a consequence more widely appreciated.

AN ENGINEER, Clarence D. Howe, of Massachusetts, has been appointed to the Cabinet of the new government in Canada. Mr. Howe is to head the new department into which the departments of marine and that of railways and canals are to be consolidated.

WHAT did the governor of South Carolina say to the governor of North Carolina? One answer to this classical and nonsensical question might have been, "I'll remove the state highways commission from office if I have to use the militia." Governor Johnston, of South Carolina, did just that last week.

ENGINEERING WORK on California's Central Valley Project officially began this week when Walker R. Young took charge and detailed H. S. Williams to complete topographical surveys of the Friant Reservoir site on the San Joaquin River. Other data will be sent to the Bureau of Reclamation designing office at Denver as rapidly as possible.

LAST WEEK Bureau of Reclamation engineers began taking soundings of the Columbia River at the Grand Coulee Bridge, one of whose piers shifted dangerously, as outlined in this issue. It is desired to learn if the earth pressures caused any changes in the bed profile.

CHICAGO'S Jane Addams slum-clearance and low-cost housing project was enlarged by about 15 acres last week. The PWA allotted $5,000,000 to be added to the previous $1,500,000 commitment. A new $1,000,000 project was also announced for Evansville, Ind., as well as one of $435,000 for Enid, Okla.

WATERWORKS MEN in New Jersey formed a New Jersey Section of the American Water Works Association last week. Previously they have been identified either with the New York or the Four States' sections.

In This Issue:

MINNEAPOLIS AND ST. PAUL are engaged in a huge sewage-disposal program, one part of which is the driving of 35 miles of sewer tunnels through the characteristic sandstone that underlies the locality. By excavating this rock, so as to pulverize it, and then mixing these fine particles with water, the rock can be pumped out of the tunnels. This unique adaptation of hydraulic mining methods to tunneling is the subject of the lead article.

MICHIGAN EXPERIENCE in transferring its township roads to county control under the supervision of the state highway department is discussed from the legal and administrative viewpoints, as an aid to other states concerned with similiar problems.

BUILDING OF THE Rip Van Winkle Bridge across the Hudson River near Catskill, N. Y., involved such significant operations as the use of a modified sand island method for pier sinking and the concreting of the deck by means of a concrete pump outfit.

TILTING of a main pier of the 550-ft. span steel cantilever bridge at Grand Coulee Dam caused by pressure from the glacial drift which it penetrates to rock narrowly missed causing the collapse of the east half of the bridge. The facts with respect to the shifting and the remedial measures undertaken are reported.

JOHN F. STEVENS continues his recollections in writing of the two years he spent in modernizing the operations of the New Haven Railroad following his strenuous years at the Panama Canal. This chapter was written before there was any word of the New Haven's present financial difficulties.

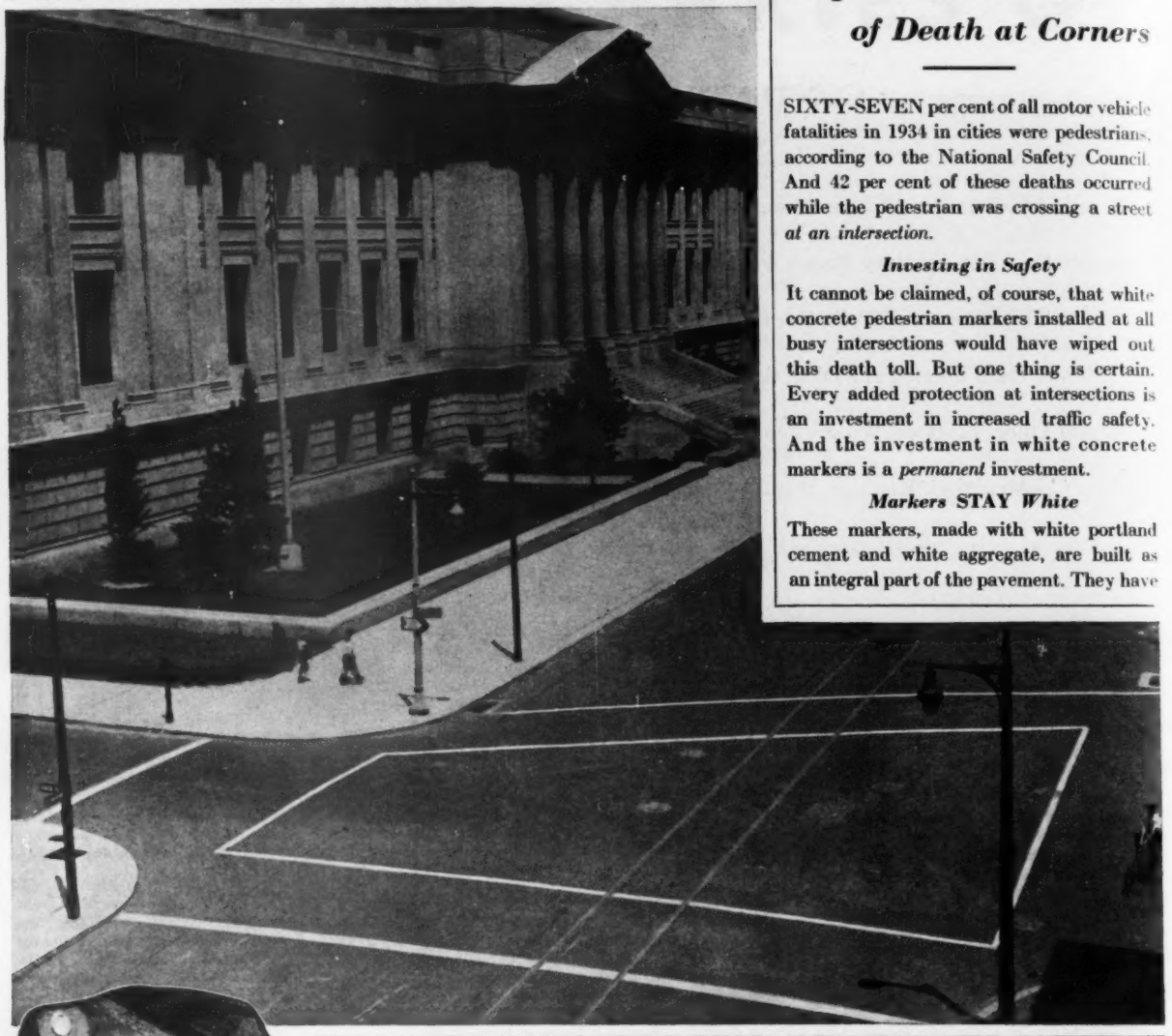
AS ANOTHER STEP in the development of the Tennessee River for navigation the Tennessee Valley Authority has begun construction of a dam at Pickwick Landing, 53 miles below Wilson Dam.

Coming Articles:

ITALY has been busy for the last few years regaining some of the prestige in roadbuilding that was hers in the days of the Cæsars. From one of the most backward of European countries in the matter of modern roads, Italy has rapidly risen to front rank not only in the homeland but in her African colonies. Two articles covering this roadbuilding resurrection will be published next week. One, by B. R. Root of the U. S. Department of Commerce, is based upon reports from members of the consular service. The other is an account written by Prof. J. S. Crandell, of the University of Illinois, following a recent visit to Italy.

WHITE MARKERS GUARD CROSSINGS

PROTECTION FOR PEDESTRIANS



Help Cut Down Toll of Death at Corners

SIXTY-SEVEN per cent of all motor vehicle fatalities in 1934 in cities were pedestrians, according to the National Safety Council. And 42 per cent of these deaths occurred while the pedestrian was crossing a street *at an intersection.*

Investing in Safety

It cannot be claimed, of course, that white concrete pedestrian markers installed at all busy intersections would have wiped out this death toll. But one thing is certain. Every added protection at intersections is an investment in increased traffic safety. And the investment in white concrete markers is a *permanent* investment.

Markers* STAY *White

These markers, made with white portland cement and white aggregate, are built as an integral part of the pavement. They have a dense, hard, white surface that traffic stains and weather cannot blot out or wear away. They *stay* white. Once installed, they last as long as the pavement lasts—always on the job, always easy to see.

Valuable Information

For complete information on these indelible white traffic markers that never need replacement, write to Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

Atlas White concrete pedestrian lane markers guard this intersection on 20th Street in Philadelphia by the Benjamin Franklin Memorial. Installation by Eastern Asphalt Co., Philadelphia, under the direction of Dudley T. Cornung, Chief Engineer, Philadelphia.

★ ★ ★

White concrete pedestrian markers can help to cut down intersection fatalities—they are a permanent investment in traffic safety

190

Build Safety into Streets and Highways with

ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement—Plain and Waterproofed

ENGINEERING NEWS-RECORD

November 7, 1935

FIG. 1—HYDRAULIC REMOVAL of pulverized sand-rock on Twin Cities sewer project strikes a new note in tunneling. The powdered rock is washed down into the pool in the foreground ready for pumping to surface.

Hydraulic Mining on Twin Cities Sewer Tunnels

Pulverized sand-rock muck in water suspension is pumped from heading to top of shaft or to portal by centrifugal pumps and boosters in Minneapolis-St. Paul intercepting sewers, after the faces of the headings are broken down by air jets, power chisels and occasional blasting

TAKING ADVANTAGE of peculiar characteristics of the sandstone rock that underlies the Twin Cities, contractors and city construction forces on several sections of the Minneapolis-St. Paul intercepting sewer tunnels have developed a most unusual method of muck removal. Spoil is handled from the headings by pumping, and the whole operation thus is more like hydraulic mining than normal tunnel-driving.

The white sandstone rock, which is very stable in the undisturbed state and requires timber supports only in the arch of the largest tunnel sections, is easily broken down to a fine sand by air chisels or spades or by blasting; when mixed with water this sand goes into a suspension that can easily be pumped through long pipe lines to the portal, or, with the aid of boosters, to the top of access shafts.

The friable texture of the sand rock has been familiar in local construction for many years. Numerous sewer tunnels have been driven through the formation, but always by fairly normal procedure. Not until the present interceptor program was placed under construction was the pumping method of muck removal tried in place of conventional car haulage. One contractor conceived the idea of using the method and tried it out with a vacuum-type steam pump. The results proved the method feasible, and soon standard centrifugal pumps were introduced, followed by centrifugals fitted with rubber bearings, rubber impellers mounted on steel disks, and rubber-lined casings. This last form of pump made the process a practical success, for until the rubber-equipped pump was introduced the metal parts had worn out quickly under the abrasive effect of the sand, which meant frequent and costly repairs.

Up to the present St. Paul and Minneapolis have always dumped their sewage into the Mississippi River without treatment. The progressive canalization of the river, starting with the completion of Dam No. 1 (within the city limits of Minneapolis) in 1917, made this method of disposal constantly more objectionable. For years there has been a stagnant pool of sewage behind Dam. No. 1. A joint sewage-disposal system has long been planned, but jealousies arising from the traditional rivalry of the cities thwarted progress. The situation was brought to a head on July 5, 1933, when the state

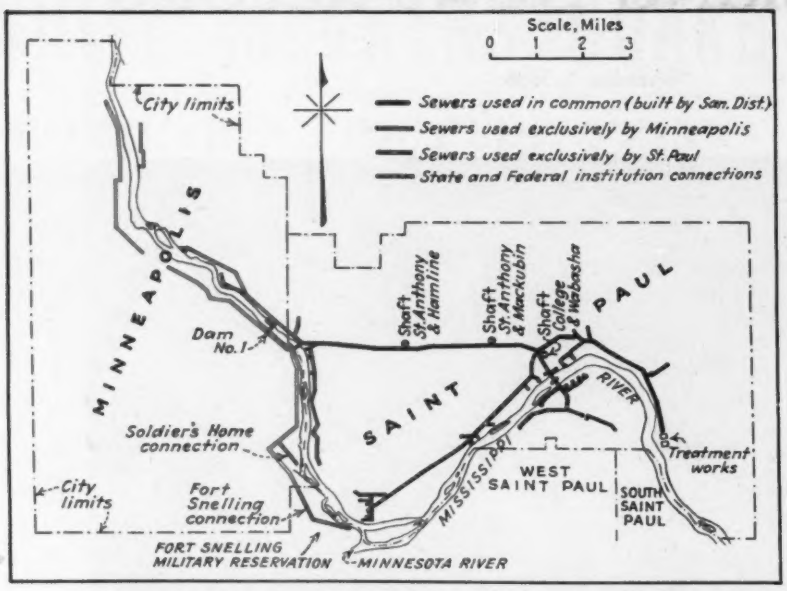


FIG. 2—INTERCEPTING SEWER SYSTEM that will end pollution of the Mississippi River at the Twin Cities is a joint project of Minneapolis and St. Paul, each city building its local lines.

board of health, taking advantage of a legislative act creating a sanitary district of the Twin Cities, ordered that discharge of raw sewage into the river be stopped.

Pursuant to this order the Minneapolis-St. Paul Sanitary District Commission was organized on Oct. 20 of the same year. An engineering organization was perfected, and a consulting board was eventually appointed. The federal Public Works Administration provided $18,048,000 for construction purposes, of which $4,212,000 was a grant. After much controversy involving the city authorities, the district commission and the PWA, construction finally got under way on July 13, 1934.

The plan provides for sewage-treatment works on the left bank of the river near the southern limits of St. Paul. Extensive interceptors are required, for both cities had developed their sewer systems with river outfalls. Under the joint plan, each city builds the interceptors that it will use exclusively, while the district builds the sections to be used jointly as well as the disposal plant (Fig. 2).

One 9-mile main trunk constitutes the districts section of the interceptor system. It begins near the Town and Country Club, at the western limits of St. Paul, and traverses the heart of the city; it consists of two open-cut box sections, 2,500 and 6,100 ft. long, one siphon 600 ft. long, and 39,570 ft. of elliptical or circular (contractor's choice) tunnel, generally 11 ft. 9 in. and 13 ft. 10 in. in diameter inside the concrete lining. All of the district's work is done by contract.

St. Paul has 75,000 ft. of small interceptors to build, all in tunnel. These vary in size and shape; the largest is a 5½-ft. elliptical concrete-lined section. Some of the smaller sections are lined only in the invert or in the lower half. All of St. Paul's work is done by contract.

Minneapolis, following long-established practice in its municipal construction, is building its share of interceptors by day labor. Its work includes 14 miles of tunnel and 4 miles of open cut. The largest tunnels are 9½-ft. elliptical; the smallest 3½x6 ft. All are concrete-lined.

Various cross-sections of the sewers are shown in Fig. 5. All of the St. Paul and Minneapolis tunnels and most of the district's tunnel traverse the white sandstone; part of the district's construction is in glacial drift, as indicated in Fig. 4.

Rock cut by air jet and bull points

Hydraulic muck removal has been developed to the highest degree on two sections of the main interceptor and on the Minneapolis city sewers. These will be described in detail as typical of the process.

On the 5,300-ft. length of contract 105 of the main interceptor, the Frazier-Davis Construction Co., of St. Louis, is driving headings both ways from the bottom of a 200-ft. shaft. This section

FIG. 3—ONE of the pumping plants. The mixture of sand and water is picked up at the collecting pool near the heading face by the rail-mounted pump at the left and is forced to the two boosters (right) at the shaft bottom for pumping to the surface.

is circular, 11 ft. 9½ in. in diameter inside a 12-in. reinforced-concrete lining, and lies entirely in white sandstone. It is extremely wet, and heavy flows of water that enter through seams in the sand rock necessitated the installation of ample pumping equipment. The wet ground also made a tile underdrain necessary, a feature required in nearly all the tunnels.

Driving is by the heading and bench method; final trimming of the sides and bottom is done later when the drain trench is dug. In advancing the heading face, the first step is to undercut the face by means of an air saw, which is a five-fingered manifold high-pressure jet on the end of a ¾-in. pipe. The facility with which this air jet cuts a deep horizontal slot through apparently hard rock is amazing.

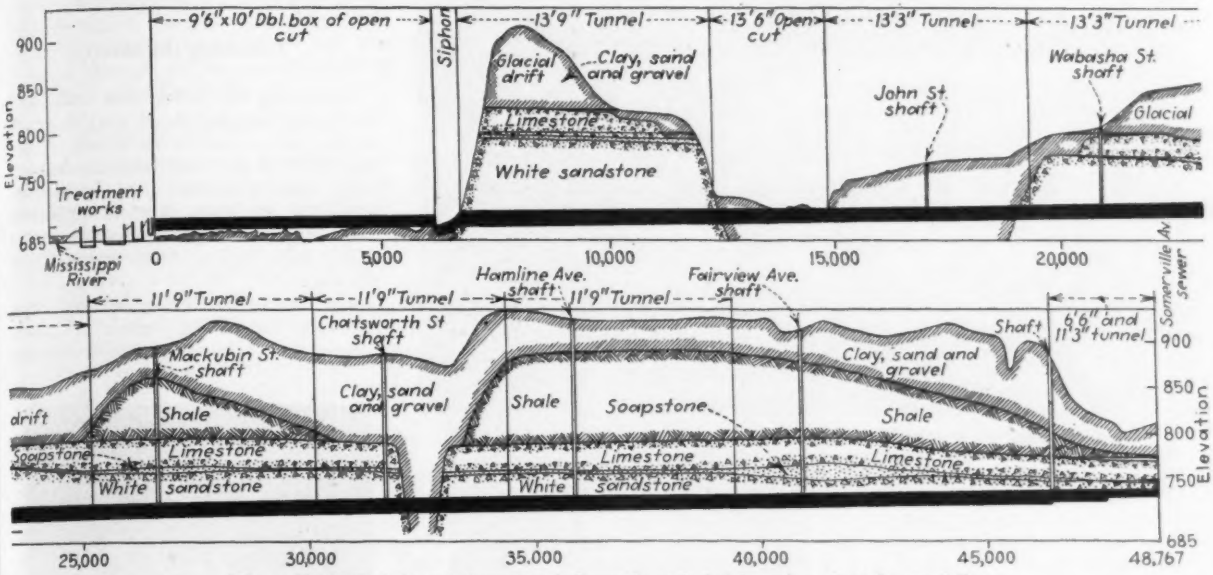
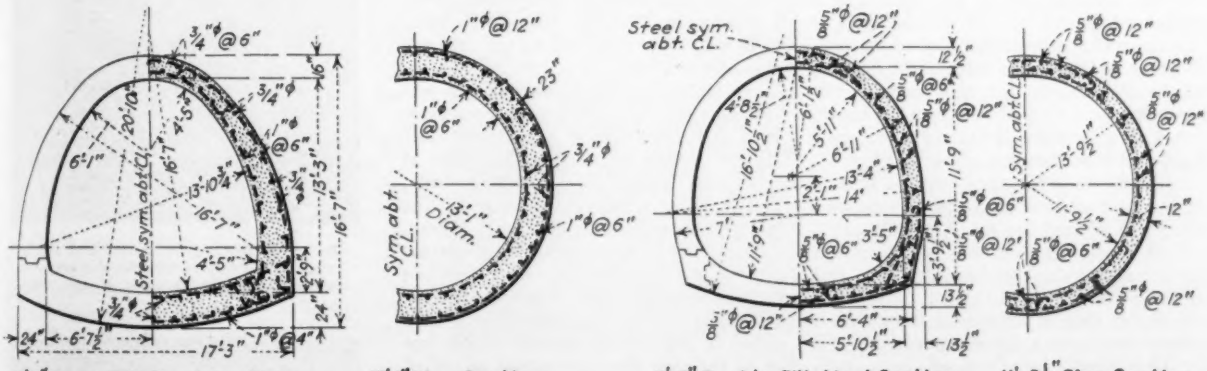


FIG. 4—PROFILE of the main interceptor indicates the geological formations along the tunnel line.



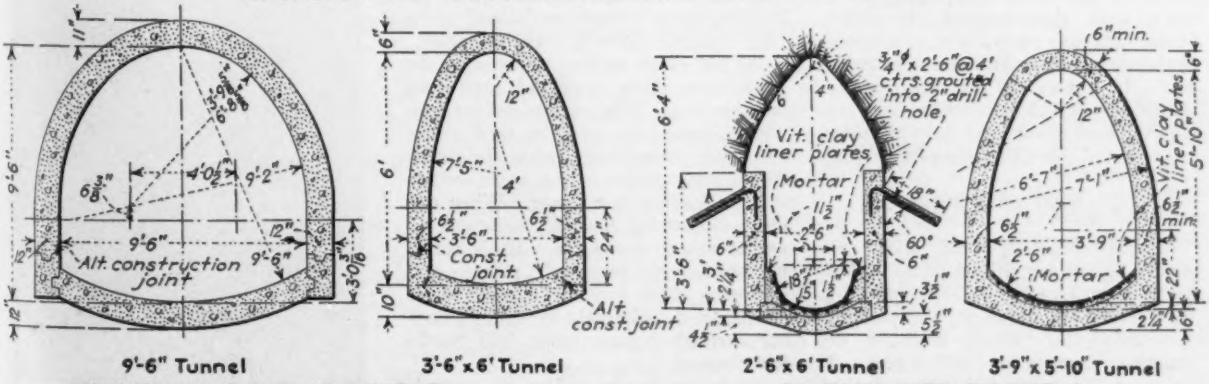


FIG. 5—MANY VARIETIES of cross-sections of tunnels are found in the intercepting sewer system, but these are typical for each of the three groups.

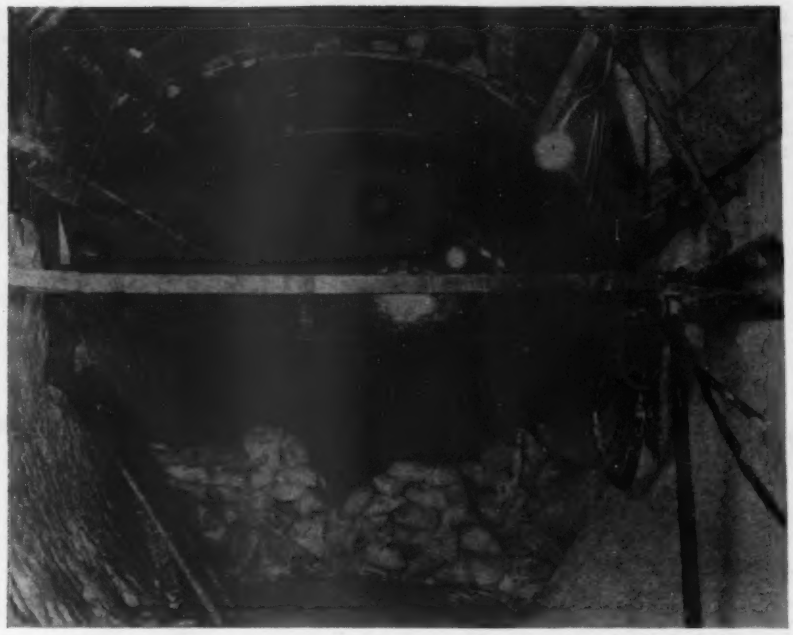


FIG. 6—HEADING in which a dike of sandbags has dammed up the sluiced muck temporarily as an aid in controlling the flow to the pump. Note the type of roof support, different from that shown in Figs. 1 and 3.

After the undercut is made, the face is broken down for a depth of 4 to 5 ft. with sharp-pointed air chisels. These chisels cut off a slice of rock several inches thick, the rock disintegrating to fine sand. As fast as the heading is advanced, five-segment timbering, consisting of 3x10-in. timbers laid flat and jointed skintight, is placed in the arch, bearing on a wall plate set on the bench.

A narrow ditch is carried along each side of the heading floor (Fig. 1), through which the sand muck is flushed from face of heading back to a collecting pool beyond the bench, usually about 25 ft. away. Often the flow of water from seams in the heading face and sides is sufficient to wash down the sand, but usually flushing is done with a water jet from a hose line.

The bench is advanced in a preliminary cut along with the heading progress, the bench face being broken down with sharp-pointed air chisels. Water jets also wash the sand produced by this operation down into the collecting pool. In cutting out the bench, a wide shoulder is left along each wall to support the arch timbering; these shoulders are removed when the trimming is done.

Sand pumping

In the collecting pool is a rail-mounted 4-in. centrifugal pump of 500-g.p.m. capacity, electrically driven (Fig. 3). To reduce abrasion, the pump is water-lubricated, which leaves a net pumping capacity of 400 g.p.m. It picks up the sand and water flushed down into the pool and forces it through a 4-in. line to the bottom of the shaft, a maximum distance of 3,600 ft. (the headings are of unequal length). At the shaft two booster pumps pick up the water-sand mixture and force it to one of three bins above street level through 4-in. risers. The two headings are worked independently, each being equipped with one pump at the face and two at the shaft.

Accurate determination of the percentage of solids pumped has not been feasible, for varying conditions constantly change the mixture and rate of flow. The pumps operate continuously, though their speed can be varied. The pumps, when equipped with 30-hp. motors, were guaranteed to operate against a 65-ft. dynamic head. When the discharge line had reached a length of 1,700 ft., it was found necessary either to put another booster in the line or to increase the size of the motor of the heading pump. The latter course was chosen, and a 50-hp. motor carried the operations through to the end of the long heading, 3,600 ft. from the shaft.

At the street surface, adjacent to the shaft, are three overhead steel-lined wooden bins. The pumps deliver into one of these bins, and the sand settles out almost immediately, while the supernatant water passes over a waste weir to a drain leading to a sewer. When one bin is almost full of sand, the flow is diverted to an empty bin. Each bin is equipped with two well points, and operating these for five minutes dries out the sand sufficiently to permit dumping through bottom gates into trucks for disposal.

While the heavy inflow of groundwater has caused considerable trouble on the Frazier-Davis job, it has not seriously delayed progress. The heading drains naturally, directed up the slope of the interceptor, while the excess water in the lower heading has to be pumped to the shaft. At the shaft are two 1,400-g.p.m. and four 500-g.p.m. electric-drive centrifugals for boosting the clear water to the surface through two 8-in. and one 4-in. risers. At times the inflow into the tunnel has reached 3,200 g.p.m.

Trimming the invert

Trimming the lower side walls and invert and digging the drain-tile trench are the last excavation operations. At the time these notes were taken in August, main excavation had just been completed on the lower heading (1,500 ft. long) and trimming and pipe-laying were under way, having been started from the shaft.

For this work the procedure is to excavate the drain trench with air chisels, and at the same time to trim the

FIG. 7—RUBBER IMPELLERS and casing linings in this type of centrifugal pump successfully resist the abrasion of the sand.

FIG. 8—TRIMMED to a pointed arch, the upper half of a St. Paul local sewer tunnel in sandstone is left unlined. Split vitrified tile forms the invert.

lower half of the tunnel to true shape, washing all muck to the bottom of the trench with water jets. A sand pump, the same as was used in the main headings, is kept at the point of operation, pumping the sand and water back to the boosters at the shaft. As fast as a section of trench is excavated, the tile is laid and the trench is backfilled with gravel. All the main interceptor tunnel will be lined with reinforced concrete, but Frazier-Davis had not installed their concrete plant at the time the job was visited. Don H. Blanks is superintendent for the Frazier-Davis Co.

George R. Cooke contract

On a near-by section the George R. Cooke Co., of Detroit, driving 5,000 ft. of tunnel through sandstone from an intermediate shaft, also is having trouble with groundwater. A steady flow of 3,000 g.p.m. is coming in within 100 ft. of the shaft, and the headings are always wet. Maximum pumpage has exceeded 4,000 g.p.m.

The heading-and-bench method, with a short bench, is used for excavation. Mining is by means of sharp-pointed air chisels. Sand broken down from the heading face is washed down a central trough cut in the bench (Fig. 6) to a collection pool. Muck from the bench excavation (which is trimmed at once to final section, including the drain trench) is also flushed to this pool.

Sand-pumping equipment is similar to that on the Frazier-Davis contract (one pump at the face and two boosters at the shaft for each heading) except that when the discharge line reached 1,500 ft. another booster was put in the line instead of increasing the size of the motor. A force pump is required at each heading to provide pressure for flushing. Muck disposal on this job is simple, as the water-sand mixture can be wasted into an adjacent low area; the sand rapidly settles out, and the water drains off through a city sewer.

Roof support in this tunnel consists of semicircular steel-channel ribs spaced 6 ft. and braced by wooden longitudinal struts, carrying tight 2-in. lagging.

Concrete for lining is brought into the tunnel from a mixing plant at the surface in small dump cars. The first step is to pour a 90-deg. section of invert in steel forms, after the drain tile has been set and the trench has been backfilled. The side walls and arch are then placed by concrete gun in steel forms.

Harry Keerl is superintendent for the George R. Cooke Co.

Work on the St. Paul section

As its share of the intercepting system, the city of St. Paul is building some 14 miles of small sewers, mostly in sand-rock tunnels, all to be done by contract, at an estimated cost of $2,250,000. To date, 45,000 ft. has been completed; 30,000 ft. more is just getting under way.

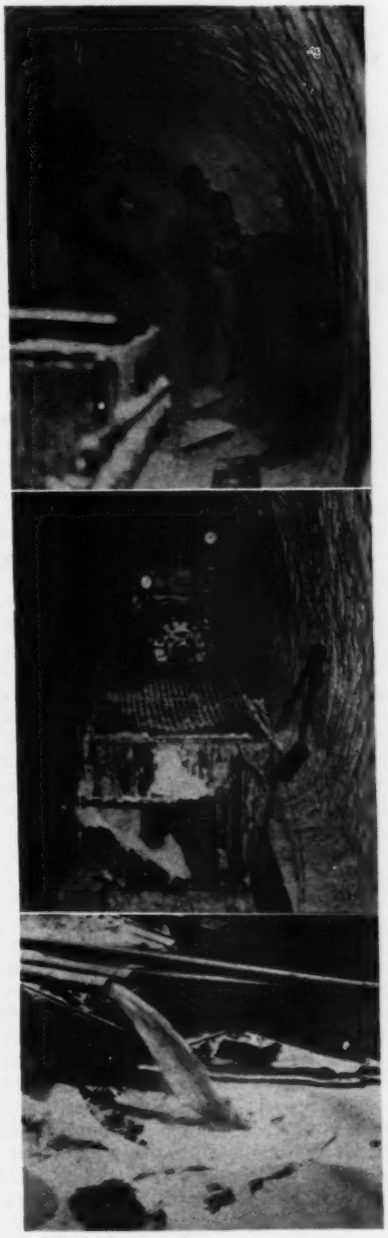


FIG. 9—REMOVAL OF MUCK in the Minneapolis local sewer tunnels starts with hand-shoveling of the blasted rock into a mixing trough, whence it is pumped to the portal. Final disposition of the sand-water mix is in a side gully on the river bank.

Sand-pumping with a different arrangement is found on these tunnels. As all of the bores are small (6x5-ft. maximum), hand work predominates. The usual excavation procedure is to break down the full face with air chisels, though occasionally holes are drilled for light blasting. The pulverized muck is carried to the shaft bottom in wheelbarrows, but here the fine material is dumped into the hopper of a standard pneumatic concrete placer, such as is used for tunnel lining, and is blown to the top of the shaft for disposal. This scheme works very well, resulting in satisfactory progress. The average heading advance is 10 to 11 ft. per five-hour shift; the maximum has been 26 ft.

Very little timbering is required, and most of the headings are dry. In many of the sections the rock is so sound that only the invert is lined, while the upper half is cut to a Gothic arch (Fig. 8).

Minneapolis does air-drilling

Minneapolis, with its day-labor construction organization, has brought the sand-pumping on small tunnels to a high degree of perfection. The entire 14 miles of tunnels in this city's intercepting system lies in sandstone. No temporary support is required, but the city is lining all tunnels with concrete.

Blasting is the preferred method of excavation, full-face headings being drilled either by hand or with air tools. Regular rock drills are used for the most part when air is available, though on some headings the holes are bored with a single high-pressure air jet. Headings are advanced 5 ft. per round with light charges of powder.

In the Minneapolis tunnels the pulverized muck is shoveled by hand into a mixing box, into which a water line also discharges. A rubber-fitted pump, the same as was used in the larger tunnels in St. Paul, picks up the sand and water from the mixing box and pumps it to portal or shaft. As all of the shafts are shallow, boosters are not required (Fig. 9).

In general, the tunnels lie along the river bank. Mixing water is pumped in from the river, and in many cases the pumped material is deposited in small ravines near the river. When this method of disposal is not convenient, boxes at the top of the shafts receive the material preliminary to truck removal.

At first sand ejectors were tried at the mixing boxes. These were found to be satisfactory for discharge distances up to 700 ft. Adding a booster ejector to the line raised the permissible length of discharge to 1,500 ft. However, because of the ultimate need of centrifugal pumps, most of the headings were equipped with them from the start.

Forced ventilation through canvas ducts is common, to keep the headings free of dynamite smoke.

Direction

William N. Carey is project engineer for PWA on the intercepting system. For the Minneapolis-St. Paul Sanitary District, C. C. Wilbur is chief engineer and C. R. Raiter is construction engineer. The consulting board for the district at the time of its organization consisted of Gen. Chas. W. Kutz, Prof. Frederic Bass and Wm. N. Carey. Geo. M. Shepard is city engineer of St. Paul, and John M. Reardon is general superintendent of sewers. In Minneapolis, Fred Paul is city engineer and Robert Houston is sewer engineer.

Michigan Law and Procedure for Tertiary Roads

A review of the legal action and administrative process by which township roads have been successfully transferred to county control under state aid and direction

By C. W. Lucas
Acting Director of Public Relations, State Highway Department, Lansing, Mich.

THE TOWNSHIP ROAD in Michigan passes on to certain oblivion. In less than five months from now this institution, almost as old as the American nation itself, will be blotted out of existence. On April 1, 1936, the county road commissions of Michigan will take over the last parcel of township-road mileage remaining in the respective counties.

There will be no mourning, however. The popularity of the township road had been waning for more than a decade, although it took the depression to bring its death. Property values slumped, and local governments hovered on the fringe of bankruptcy. The township road became a tax burden which the people could not stand, and in 1931 the legislature, responsive to a cry that arose over every farm land, enacted a statute directing that the counties absorb the township roads of the state by 1936 by taking over 20 per cent of the mileage each year.

Terms of the law

The Michigan township road law is Act No. 130 of the Public Acts of 1931, but it is known throughout the state as the McNitt Act in honor of Representative H. Earl McNitt, of Cadillac, who led the movement for its enactment. The bill was the result of much study and many conferences on the part of the Michigan farm, roadbuilding and highway organizations, and when it was introduced the measure was accorded widespread support.

Counties at that time were receiving allotments from the weight and gasoline taxes for the construction and maintenance of the county roads. Under the law township roads did not benefit from these funds, so it was proposed to give the townships some means of sharing in the weight and gasoline tax receipts. Since the county road commissions were maintaining roads in all sections of each county and in most cases had equipment for this purpose, it was deemed most advisable to incorporate the township mileage into the county system rather than to allocate part of the weight or gasoline-tax receipts to the township units. The McNitt Act was the means finally adopted for accomplishing this purpose. Briefly the act provided:

1. That the state highway commissioner should determine and certify to the board of county road commissioners the total mileage of township roads within each county and within each township of each county.

2. That, by April 1, 1932, and on the same date for each of the succeeding four years the county road commission would take over 20 per cent of the township road mileage within its county as certified by the state highway commissioner. This mileage was required to be selected in accordance with the following regulations: (a) post roads were to be given preference; (b) roads selected must be contiguous to or connecting with the county road system, state trunklines, or the most heavily traveled village or city streets; (c) the roads must have approval of the state highway commissioner.

To compensate the counties for absorbing this additional road mileage, the act appropriated from state highway revenues $2,000,000 in the calendar year 1932; $2,500,000 in 1933; $3,000,000 in 1934; $3,500,000 in 1935; and $4,000,000 in 1936 and each year thereafter. This money is apportioned among the counties by the state highway commissioner on the proportionate basis of the township road mileage within the county compared with the total township mileage in the state.

These funds are spent by the counties to maintain the roads that are taken over, but any amount remaining after maintenance charges have been met can be devoted to improvements. If this excess is not sufficient to care for necessary improvements, the county and township share in the cost. Counties do not receive any yearly allotment until a report of receipts and disbursements for the previous year has been received and approved by the state highway commissioner.

Obviously, this act greatly increases the obligation of the county road commissions. On Jan. 1, 1931, the total county road mileage in Michigan was 17,301 miles. This total will be increased to nearly 88,000 miles of county roads next year, when the township road will disappear. In most cases the county road commissions are in a position to assume this added responsibility with the $4,000,000 that will be apportioned annually among Michigan's 83 counties from the gasoline-tax revenues.

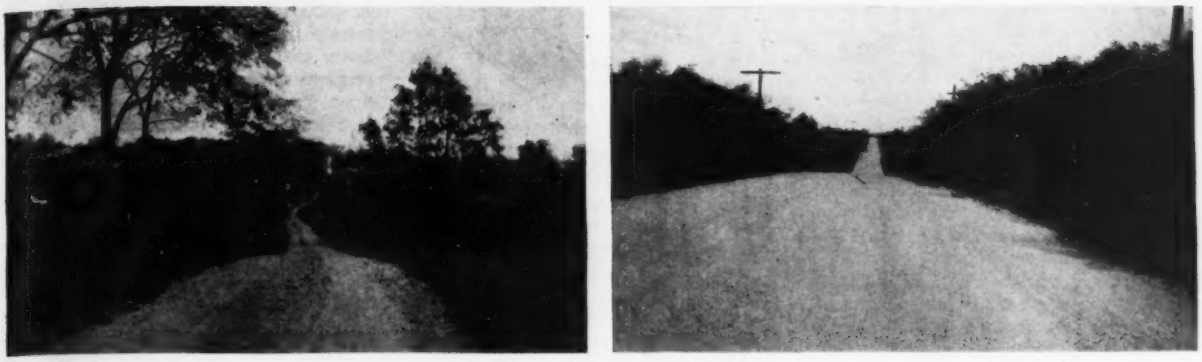
The act met some opposition from counties where corporations had large property holdings. In these counties it was possible for the townships to tax the corporations for road purposes and at the same time incur little added expense to the local, individual property owners.

• In an administrative sense the problem of the tertiary road exists only where the township has and exercises independent power over its roads. This situation prevails particularly in the New England states and less definitely in the states of the north Atlantic and north-central groups. In the south and farther west the county exercises controlling authority over all roads that are not specifically included in the designated state systems. Broadly, the tertiary road problem is the township road.

• Township roads generally have become inefficiently developed due to lack of funds and of technical skill and equipment to meet the road construction standards required for modern traffic. In the years of recent business depression these restrictions have been emphasized, and an evident disposition has developed, largely impelled by the desire for tax relief, to hand local-road control over to larger governing bodies. The methods have differed widely; in Connecticut, for example, state direction enters through state money aid to the townships; in Pennsylvania large mileages of township roads have been taken directly into the state system; and in Michigan, as described in the article that follows, all township roads are being absorbed by the county systems.

• The Michigan procedure commands special interest because of its planned effort not to bring about a too rapid and disrupting change in local-road administrations and because it recognizes evident advantages in intelligent subdivision of financial obligation and directional responsibility for highway service. In this article the Michigan plan is considered from the viewpoint of law and administrative procedure rather than as an engineering planning and construction problem. Essentially the engineering and conconstruction have been only a sound application of modern principles and practices of roadbuilding.

—EDITOR.



TYPICAL township road in Michigan before and after it was absorbed and improved by the county.

In most cases, however, the act is accepted as a major relief measure for property owners who have had to pay the cost of township road construction and maintenance.

Administrative problems

When the McNitt Act went into effect, many problems of administration immediately arose. In the first place, the act stated that "The state highway commissioner shall, immediately upon the taking effect of this act, ascertain and fix the total township highway mileage in each township in the state as of Jan. 1, 1931." This in itself was a considerable task. Rules governing the procedure to be used were compiled by the state highway commissioner and sent to each county road commission. They read in part as follows:

> It is requested that you call together each township board in your county as soon as possible and have the township system marked in yellow on the enclosed township map. The roads shown should be the township system as of Jan. 1, 1931, and all changes since that time should be disregarded.
>
> After each township map is completed, request the township board to sign the enclosed certification in triplicate. One of these copies may be retained by the township board, one in the county files and the third attached to the township map to be returned to the state highway department.
>
> Every township map with the attached certification by the township board together with one copy of the county map, with a letter of transmittal properly signed, should be returned to the state highway department.
>
> The attorney general has written an opinion in which he states that the act does not definitely define a "township highway" but confers considerable discretion upon the highway commissioner. He states that, "A common-sense definition of that term would therefore seem to include or mean all of those traveled highways in a township not a part of the county road system or the state trunkline system, excluding roads in cities."

When the maps were returned to the state highway department properly certified, the statistical bureau transferred the township road mileage from the township maps to the county maps and determined the total mileage of township roads eligible to be taken over in each county. The ratio of this total for each county to the total township mileage in the state was then established as the basis for the apportionment of the annual payments to the counties.

This procedure took care of that section of the act providing that: "The state highway commissioner shall ascertain and fix the total township highway mileage in each township in the state as of Jan. 1, 1931 . . . , and not later than Sept. 1, 1931, he shall certify to the board of supervisors and the board of county road commissioners of each of the several counties of the state the total township mileage for each township in the several counties, together with the total of such mileage for each county. . . . ."

With the mileage determined and certified, the next problem was to establish a system for the actual adoption of township roads by the county road commissions. The first step in this procedure was to make linen blue-line print maps showing the eligible and certified township mileage in each county. Mileage was indicated by actual numerical figures for each parcel of road. A positive photostatic copy of this map was furnished each county for the purpose of indicating thereon the mileage proposed for adoption.

The mileage taken over as the first 20 per cent was indicated on these maps by an *A* at the beginning and end of each parcel adopted. Mileage adopted the second year was indicated by *B-B*, and the third year by *C-C*, etc.

During the first few years that the act was in operation considerable correspondence and extra detail were involved in solving minor problems as they arose. At this time, however, a regular series of letters and forms has been evolved which handles the annual adoption of roads with a minimum of difficulty.

Early in February a form letter signed by the state highway commissioner, together with a positive photostat map and blank form of certification, is sent to each board of county road commissioners. The section of this letter that is devoted to instruction to the road commissioners reads this year as follows: "Kindly mark in red on this (photostat) map, the roads you propose to adopt in April of this year as the 20 per cent for 1935. When marked, please return this map to this office with one copy of the certification which we are also enclosing."

A notation at the end of this letter indicates the total township mileage approved in 1931 and the total adopted as of July 1, 1934. A further notation points out that the minimum mileage to be adopted in 1935, plus mileage already adopted, must equal or exceed 80 per cent of the total mileage determined in 1931. The figure 80 per cent is used, since 20 per cent of the McNitt mileage had been adopted in each of the previous three years.

The certification to which reference has been made is set up by the state highway department and is merely a statement that the instructions given in the letter have been carried out. Blank spaces are left for the signatures of the county road commissioners.

When the map, upon which the county officers have marked the roads proposed for adoption, is received by the state highway department along with the certification, the mileage selected is checked against the eligible mileage record as kept by the department. Any exceptions for which no credit can be given are listed, and the county is advised of their rejection.

The next step is the state highway commissioner's formal approval to adopt as provided in the act. This is accomplished by another circular letter set up over the commissioner's signature. The county is instructed to proceed with the legal steps necessary to take over the township roads. A blank form for certifying that these steps have been taken is enclosed in the letter.

The McNitt Act itself contained no provisions to govern the procedure for taking over the township roads. An opinion from the attorney general, however, pointed out that the county road commissioners could proceed under the terms of another act passed in 1909, which set up the method for taking township roads into the county system. No doubt most states already have a system for taking roads from one jurisdiction and placing them in another, but for those that do not, the one used in Michigan may be elaborated upon.

The law provides: "Any road theretofore laid out, or any part thereof, shall become a county road if the board of county road commissioners shall at any time so determine." Clerks for the board of county road commissioners are required to advertise for three weeks in a weekly newspaper that has county-wide circulation, listing the various parcels of road to be taken over. Township road commissioners are then notified, and the process is complete.

Upon receipt of the certification blank included with the commissioner's formal approval to adopt, properly filled out by the county commissioners, another form letter over the commissioner's signature is sent to the county board. This is the formal approval and confirmation of the taking over of the 20 per cent of the original mileage for any one year. Included in this letter is a statement of the mileage originally determined as McNitt mileage in the county and a statement of the number of miles taken over each year to date.

Only one step remains before the counties are entitled to receive their annual payments. It is provided for in Sect. 12 of the McNitt Act, which reads as follows:

> At the expiration of each year the boards of county road commissioners shall annually report to the state highway department, upon such forms and in such manner and at such time as the state highway commissioner shall prescribe, all their appropriations under the provisions of this act, and funds appropriated by this act to any county shall not be paid out to such county unless and until the report for such county for the preceding year shall have been submitted in satisfactory form and approved by the state highway commissioner.

This clause was incorporated in the act to insure against diversion of McNitt payments for any other purpose than the improvement and maintenance of former township roads.

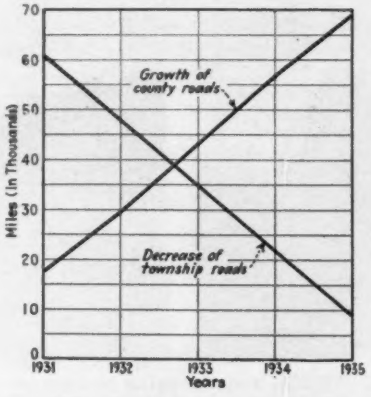
A form providing a rapid and accurate check on receipts and expenditures has been devised by the department. This form is enclosed with the letter giving the commissioner's approval and confirmation of the mileage adopted as the county's 20 per cent in any one year.

When received, this form is checked and proved, and if it is correct the county is eligible for its annual allotment of cash from state funds.

Discussion of procedure

The procedure just outlined for determining the original township mileage and for the annual adoption of 20 per cent of this mileage by the counties is the result of careful study and a certain amount of experimentation on the part of the statistical office of the state highway department. Although the act was exceptionally well drawn, certain problems arose that might well be avoided by any state contemplating similar legislative action.

One of the first problems to be met was that of county-line roads. Township mileage along county lines was allocated to the adjoinng counties in half-mile strips, which upon adoption by the counties, resulted in an inefficient method of improvement and maintenance. This condition was finally rectified by joint meetings of the road commissions of adjoining counties whereby equitable maintenance and improvement agreements were reached. However, they were required to adopt the mileage as orignally certified by the state highway commissioner. To avoid this problem, the following procedure is recommended: Give each township of 36 sections three miles on each side of the township corners, modifying irregular townships to conform. In the case of township roads along county lines this will give access to a main county-line road for maintenance.



RELATIVE MILEAGE of township and county roads in Michigan during four years' progress in transferring control

A second problem, which has recently been overcome in Michigan by the passage at the last session of the legislature of an amendment to the original act, might easily be avoided unless constitutional considerations prevent. During the four years since the original certification of township mileage was made, errors have been discovered. In some cases additional township roads have been built by township road commissions. This latter step, in a sense, defeats the purpose of the act, which was to eliminate the township as a road administration unit. The amendment referred to above rectifies this circumstance by providing a recertification of the total township mileage in each county by the state highway commissioner on or before Sept. 1, 1935. It further provides that the county road commissions shall include, along with their fifth, 20 per cent of the original certified mileage . . . "all additional township highway mileage as recertified by the state highway commissioner."

Other states planning similar legislation can avoid this difficulty by prohibiting the construction of any new township roads and declaring that all new roads shall be county roads. Constitutional provisions permitting, it would seem advisable to abolish the township road commission at the same time.

Sect. 8 of the McNitt Act, dealing with appropriations of funds, is self-explanatory and follows:

> The revenue provided under this act shall first be used for the maintenance of the roads taken over. Any remaining funds may be used for improvement of said roads. Whenever, in the judgment of the board of county road commissioners, it shall become desirable or necessary to improve any of the mileage so taken over and incorporated into the county road system, such board of county road commissioners shall prepare an estimate of the cost of such improvement. Provided, however, that any remaining funds out of the amount apportioned to such county under the provisions of this act after all proper maintenance appropriations have been made shall be devoted to and appropriated for such improvement, and any additional appropriations shall be made only when such remainder out of such fund is not sufficient to cover the entire cost of the improvement found necessary. Such estimate, together with a proposed division of the cost between the townships and the county respectively, shall be submitted to the board of supervisors on or before the first meeting of the October session of the board of supervisors in the year preceding that for which such expenditure is proposed to be made. The board of supervisors shall thereafter approve or deny such request for apropriations either in whole or in part and shall have the power to fix or change the percentage to be paid by the county and townships respectively.

Other sections of the act provide that after Jan. 1, 1932, no township shall levy a road tax except as provided above. Under no circumstances shall the townships levy a tax for highway purposes to exceed the following schedule: five mills on each dollar's valuation for 1932; four mills in 1933; three mills in 1934; and not more than three mills for each succeeding year thereafter—"except when necessary to care for obligations outstanding at the time this act takes effect . . ."

It is further provided, however, that when all the McNitt mileage has been taken into the county system, should it be found that the funds available under this act are not sufficient for the proper maintenance and improvement of the roads taken over, "the board of supervisors shall have the power to include such excess cost in its levy for general county road maintenance and shall spread such cost over the county at large."

TOWNSHIP ROAD MILEAGE ADOPTED BY COUNTY AID COMMISSIONS TO JULY 1, 1935, UNDER MICHIGAN ACT.

Total township mileage, 1931 ...	60,317.5
Mileage adopted 1932	12,316.53
Mileage adopted 1933	13,386.9
Mileage adopted 1934	13,595.65
Mileage adopted 1935	12,472.35
Total mileage adopted	51,771.43
Remaining township mileage to be adopted	8,546.07
Total county road mileage, 1931	17,301.87
Total county road mileage July 1, 1935	69,073.30

Recent progress in administering the McNitt Act has been good. At present twenty counties have taken over all the township roads within their boundaries. Benefits to the townships should accrue under the terms of the act not only from a saving in the tax rate but also from the standpoint of a better road system. It was only in rare instances that township road commissions found themselves in a position to carry on extensive construction and maintenance activities. Their services were logical and adequate when a wagon road was a highway. The township road commissions have in past years made great contributions to the development of Michigan's excellent highway system, but the state has found that further progress in this development requires the elimination of the township as a road administration unit.

Thin Concrete Shell Roof Tested Under Large Unsymmetrical Load

IN ORDER to secure data on the behavior of barrel concrete shell roofs under unsymmetrical loads and to check the results of approved calculation methods for stresses in barrel shells, load tests were made on the Brook Hill Farm dairy building roof of this type at the Century of Progress during its demolition. As described in *ENR*, June 14, 1934, p. 775, it consisted of five barrels of 14-ft. width and 36-ft. length constructed of an all-Haydite concrete proportioned 1:2½:2½ with about 6 gal. of mixing water and high-early-strength cement. Five days after the concrete for the first two barrels was placed, test cylinders showed a strength of 4,000 lb. per sq.in., and the concrete had a specific gravity of 1.66. Because of the high strength of the concrete in the first section the forms for the remaining barrels were stripped after three days. The compressive strength of 3-day test cylinders made from the concrete in the second section was 1,860 lb. per sq.in., and the modulus of rupture was 350 lb. per sq.in. The lower strength of cylinders from the second placement compared with the first was attributed not only to the shorter elapsed time before testing but also to a temperature range between 34 and 40 deg. after the second pour, as compared with 70 deg. during the curing time of the first pour. At the time of the load test on the finished structure the concrete was eight months old and showed an average compressive cylinder strength of 5,500 lb. per sq.in.

One-half the width of one full barrel was loaded with cement in bags, care being taken to prevent arching. The resulting unsymmetrical live load, 200 lb. per sq.ft., was ten times the live load for which the roof was designed, or five times the sum of the dead load plus 20 lb. live load.

Berry strain gages, Ames dials, and Wissler dials were used, and readings were taken at twenty different points at various stages of the test.

Test results

The structure, according to a report by the Portland Cement Association, showed good elastic behavior, the deformations almost fully recovering after the load was removed. Only small hair cracks occurred in the valley at mid-span, where the tensile stress in the concrete was a maximum. Due to the use of a large number of small rods instead of a few heavy reinforcing bars the cracks remained small. The diagram, which illustrates the elongation of concrete and steel in the tension zone of the loaded barrel, is a characteristic load-strain diagram of a beam. Steel and concrete deformed uniformly up to a steel stress of 7,500 lb. per sq.in.

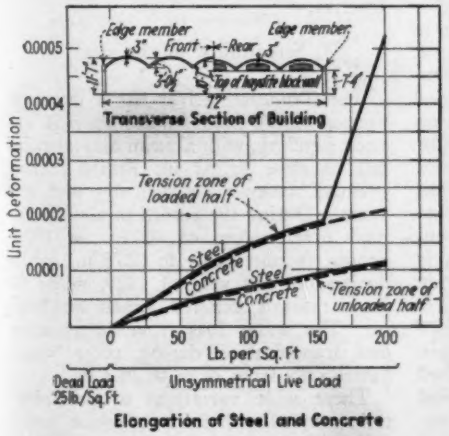
The maximum deflection in the center of the loaded valley was 0.195 in. under maximum test load, or a ratio of 1:2200 of the barrel length of 36 ft. The horizontal spread at the center of the loaded barrel was 0.027 in., or a ratio of 1:6200 of the barrel width of 14 ft.

The indicated stresses showed that the main carrying action of the roof is somewhat like the action of a beam over a span of 36 ft. The stresses in the plane of the cross-sectional curve of the roof are secondary. The deformation of this curve reconstructed from deflection and strain-gage measurements is shown at the right in the accompanying illustration. The changed curvature of the arch gives a picture of the distribution of secondary moments over the cross-section. Point A acts like a support, the loads being carried at this point by interaction of the adjacent intersecting shell. The negative bending moment of the shell at point A corresponds to the restraining action at this support. The negative moment in mid-span near the crown of the barrel can be explained, says the report, as a restraining moment at some ideal crown support. The load-carrying capacity of the curved slab at the crown being much greater than the imposed load, the shell slab at this point has a tendency to carry loads from other portions of the shell. For the secondary bending action the shell seems therefore to be supported at point A and at the crown in mid-span —i.e., at short intervals—and moments consequently will remain small as compared with those under an arch action over the full span.

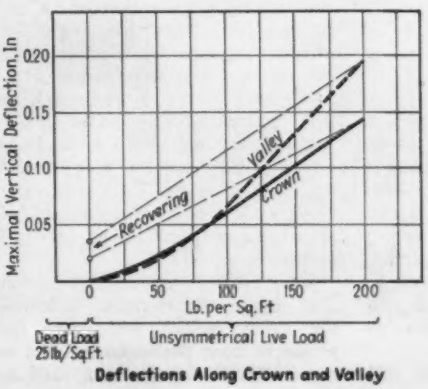
Conclusions

Since the observed deformations under unsymmetrical loads were of the same order as the calculated deflections under corresponding symmetrical loads, it is concluded that the arch action along the cross-sectional curve of the roof

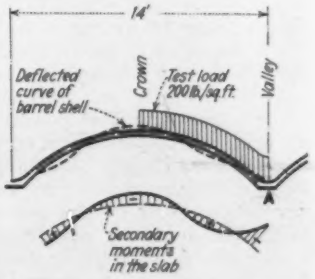
PLOTTED DEFORMATIONS in steel and concrete and deflections of a shell concrete roof under a maximum live load of 200 lb. per sq.ft.



Elongation of Steel and Concrete



Deflections Along Crown and Valley



Deflection of Cross Section of Barrel

must have been negligible. The membranous stresses in the roof slab, characteristic of a shell, kept the system in equilibrium. The main carrying action checked by strain-gage measurements can therefore be compared to the action of a beam with curved cross-section, 14 ft. wide, carrying over 36 ft. between the walls of the building.

The tests were made by Roberts and Schaefer Co., engineers of Chicago, assisted by the Portland Cement Association. They were witnessed by engineering staff members of the University of Illinois.

Third TVA Dam Under Way at Pickwick Landing

Tennessee Valley Authority begins work on another of its dams for the development of the Tennessee River—Form of valley floor results in a design unlike that at Muscle Shoals and Wheeler—No power is included in the present undertaking

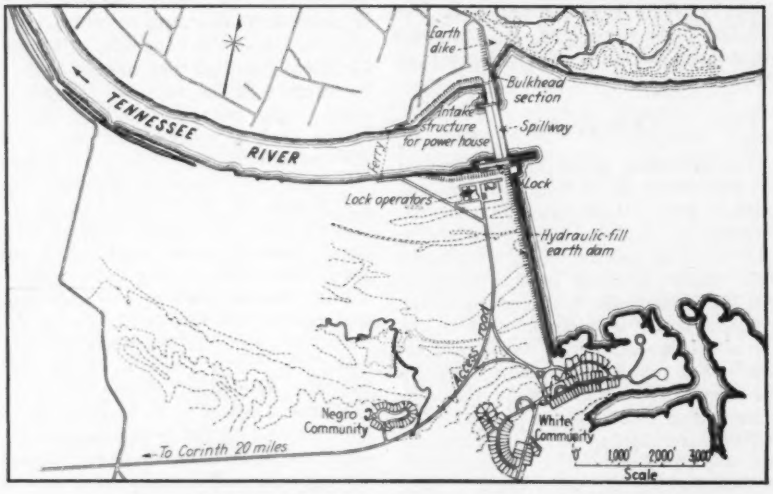


FIG. 1—AT PICKWICK LANDING the Tennessee River lies in a deep trench in a valley floor that is more than a mile wide. The navigation lock, spillway and intake for a power house to be built in the future will be across the main channel. Flanking these structures will be more than a mile of earthfill.

PICKWICK LANDING DAM, on the Tennessee River 207 miles above its mouth in the Ohio and 53 miles downstream from Wilson Dam at Muscle Shoals, is the third dam to be undertaken in the series of regulating works proposed by the Tennessee Valley Authority to render that great stream navigable for 9-ft. draft in its entire length, to control its flow to the end that flood damage will be reduced, and to develop a large amount of power.

This $36,000,000 project is considered the most economical for power development of any of the remaining sites on the Tennessee River. It will create a 9-ft. minimum depth for the least navigable stretch of the lower river. With Wheeler Dam completed and a limited amount of dredging downstream from Pickwick, a 7-ft. channel may be obtained at the lowest flows for 358 miles upstream from the Ohio to Guntersville, Ala.

For the present no power house will be built at Pickwick Landing Dam. Only the intakes for a power house will be constructed at this time to serve as part of the dam, and all necessary excavation for draft tubes and tailrace will be done now while the area is unwatered.

Decision to build this great dam in advance of the creation of an adjacent market for power that might be generated in connection with it was based largely on the assumption that the improvement of the Tennessee River for 9-ft. navigation is one of the major TVA functions. Studies made by the Corps of Engineers, U.S.A., previous to the creation of the TVA led to the conclusion that such improvement of this stream was justified as an ultimate objective.

The TVA is understood to consider that the development of industries in the valley, which will make finished products from the extensive and varied raw materials of the area, will be encouraged by the provision of low-cost waterway transportation.

Conditions at the site

The Tennessee River at the site of Pickwick Landing Dam flows almost due west with a sweep in its course which throws the channel close to the north bank. At the site the channel is in a deep trench, about 1,200 ft. wide, with abrupt earth banks rising to a height of 35 to 45 ft. above the normal water level. From the north channel bank a flat alluvial flood plain extends back about 900 ft. to a bluff. On the south side a similar flood plain is over 4,400 ft. in width before it reaches higher ground.

Limestone underlies the entire section of the country in which the project is located. At the site its surface is 17 ft. below normal low water, with earth overburden on both sides of the channel as deep as 60 ft. Extensive core borings indicated that the surface of the rock is remarkably level over most of the site of the dam. These borings also showed very few horizontal seams.

With one exception, this site presented the best location for a high dam on the lower river for some distance up and downstream. In fact, for 250 miles from its mouth the Tennessee offers few desirable sites for high dams. The normal channel of the stream is usually well confined, but bedrock is at considerable depths except for a few reefs that come close to the surface. One of these reefs occurs at the Pickwick Landing Dam site. Another, 13 miles upstream, constitutes what is known as the Parker site. A project located at the latter might cost less, but when navigation, power possibilities and all other features are considered, the Pickwick Landing site proved the most attractive.

Streamflow at the site

The Tennessee River has a drainage area of 32,870 square miles above Pickwick Landing, with a mean annual rainfall of close to 52 in. Runoff varies greatly, however, between dry and wet years. During the record minimum annual precipitation of 40 in. in 1925, runoff amounted only to 12.75 in., while during the wet year of 1929, when 60 in. of rainfall occurred, runoff was 33.7 in. The water loss from evaporation and transpiration during these years varied only from 27.25 to 26.3 in.

These wide variations in precipitation, coupled with fairly constant losses

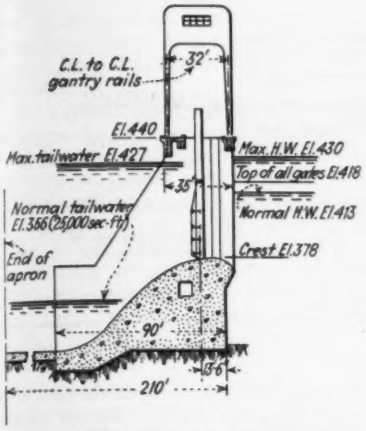


FIG. 2—SPILLWAY SECTION of the dam as tentatively designed. Because of the unusual depth of overfall this design may be modified as the result of model tests now in progress.

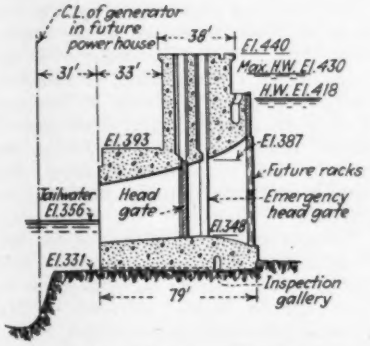


FIG. 4—AN INTAKE STRUCTURE of the design here shown is being built as part of the present undertaking. The power house is to be built at a later date.

in evaporation and transpiration, give the flow of the Tennessee a rather wide range of discharge. Frozen ground and melting snows practically do not affect the stage of the stream or its tributaries.

Minimum flow on record at Wilson Dam occurred in the fall of 1925, when only 4,070 sec.-ft. were measured. The maximum flow on record at this point was established in March, 1897, with 444,000 sec.-ft., or more than 100 times the minimum. In designing Pickwick Landing Dam the decision was made to provide spillway capacity for a maximum flow of 750,000 sec.-ft. While this is nearly twice any stage that has ever been experienced, a possible combination of storm conditions of known intensity on the watershed might produce such a vast discharge.

Completion of Norris Dam and other important storage reservoirs on the headwaters of the Tennessee will materially increase the minimum flow of the stream. To what extent they will reduce the all-time maximum flows at Pickwick Landing Dam remains a question. It is known that the 444,000-sec.-ft. flood was due largely to exceptionally long heavy precipitation over that part of the watershed below any proposed storage reservoirs.

Investigation has shown that a considerable degree of flood control can be secured by utilizing the upper ranges of the pool for flood storage. The spillway gates and lock features have been determined with this in view. Flood storage of 250,000 to 400,000 acre-ft. may be utilized to reduce peak discharges, and the cost of providing for such control, in addition to the other necessary costs of the project, is very moderate.

General features of the dam

In the comparatively narrow natural stream channel the dam will have a concrete spillway structure with an overall length of 1,156 ft. and an average height of 43 ft. from bedrock to crest, or 105 ft. to the top of the operating bridge over the spillway opening. To control the storage depth, 24 gates each 40x40 ft. will be provided, giving a total net spillway length of 960 ft. The design contemplates a maximum overflow depth of 52 ft. on the crest of the spillway, due to the comparatively narrow width of the latter and the huge volumes of flow that may have to be handled.

The typical section through the spillway shown in the accompanying figure is subject to change after completion of the hydraulic tests now under way to determine the most feasible method of dissipating the energy of the overfalling water.

Adjoining the right end of the spillway there is to be, when finally completed, a concrete power-house structure 500 ft. long, and to the north of the power house a concrete non-overflow section of dam 266 ft. long followed by 890 ft. of earth embankment to the bluff. At the opposite end of the spillway will be a navigation lock 110 ft. wide by 600 ft. long; south of this an embankment 4,682 ft. in length will extend to high ground. The entire dam thus will have an overall length of 7,667 ft.

Minimum low water in the present channel is at El. 352. Normal pool level in the reservoir will be at El. 413. Provision is made for a surcharge of 5 ft. in the pool level. The top of the south embankment will be at El. 435, which is expected to provide a freeboard of 5 ft. during the maximum stages for which the dam is designed.

Present plans for the ultimate regulation of the Tennessee contemplate a power and navigation dam about 40 miles above the mouth of the river at or near a site known as Aurora Landing. Backwater from this dam would extend at low flows in the river to tailwater of Pickwick Landing Dam. The gross head at the latter will be a maximum of about 60 ft. With a discharge equal to the 1897 flood, this would be reduced to 9 ft. For the extreme flood of 750,000 sec.-ft. considered in the design, the difference between the headwater and tailwater levels would be only 3 ft.

On account of the great flood dis-

FIG. 3—THE SHEETPILE CUTOFF WALL under the south embankment is capped with a concrete seal. Forms for the seal are being set in the operation shown in the foreground.

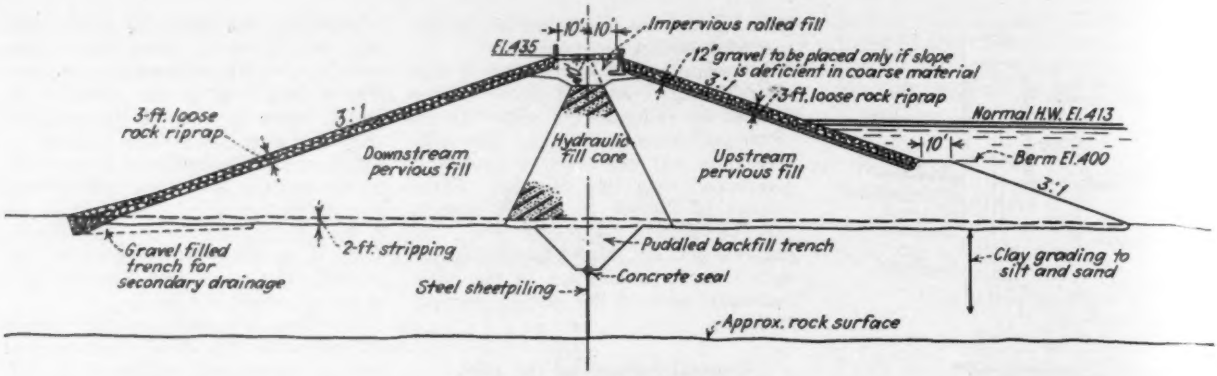


FIG. 5—THE LONG EARTH DAM is to be a hydraulic-fill structure. Because backwater may result in almost complete submergence of the dam, both the upstream and downstream fills are to be made sufficiently pervious for quick drainage without risk of slides.

charges that must be handled through the dam, it was essential that the spillway be located in the existing channel. This location also made it possible to construct the spillway in sections in a manner that would permit the most satisfactory control of the river while work was in progress.

For some distance downstream from the site, the deep section of the channel is close to the left bank of the stream. Hence, the navigation lock was placed at that end of the spillway. The length of the latter required to handle the floodflows of the stream necessitated the placing of the lock and the approaches to it in an excavated area within the left bank. Material from this excavation will all be used in building the embankment extending from the lock across the south flood plain of the stream to high ground.

Location of the power house entirely within the right bank involved the excavation of both approach and tailrace channels. This location was required, however, in order to obtain sufficient spillway openings to handle the expected flood volume. On account of the heavy excavation involved on either side, it was impracticable to combine the power house and the navigation lock on the left bank. Moreover, the material from the power-house excavation could be used to make the earth embankment at the north end of the dam.

While no power installation is contemplated at the present time, it has been necessary to prepare preliminary designs of the plant so as to develop a suitable intake structure. This design assumes that six units of the propeller type, similar in character to those at the Wheeler and Safe Harbor plants, will be installed when needed. On account of very high tailwater, the power house will have to be protected by a bulkhead on the downstream side, so that it will become a watertight box-like structure. The generators then may be set at relatively low elevations, with rather short shafts. The variation in head points to turbines of the Kaplan type.

Embankment design

Conditions at the site render comparatively simple the design and construction of the embankments extending across the flood plains on both sides of the dam. Limestone bedrock, having a normally level surface, lies 35 to 50 ft. below ground surface. Immediately over the bedrock is a stratum of coarse sand and fine gravel to a depth of 6 to 15 ft. Above the gravel is alluvial material containing a good deal of fine sand, some gravel, but principally clay.

Extensive tests showed that the flow of water through the pervious material over the rock was comparatively rapid. Groundwater levels in this layer of material correspond closely with variations in the depth of water in the river. Hence it was decided to provide a tight cutoff under the embankments.

After careful studies of the local materials and conditions, the decision was made to use hydraulic-fill methods in building both embankments. The necessary cutoff was provided by driving a line of steel sheetpiling to bedrock; the sheeting extends 5 ft. into the core of the embankment.

For the south embankment the sheetpile cutoff was driven for a distance of 3,400 ft. from the lock toward the higher ground. At this point the height of the embankment reduces enough so that studies indicated that there would be no danger of an underflow occurring through the long passage that it would have to take to reach the river channel.

Provision for a second lock adjacent to the one now to be built has been made by driving a line of sheetpiling 132 ft. downstream from the line of piling under the main embankment to form a transverse cutoff wall.

Under the north embankment the steel piling will extend to the inshore end of the dam.

With an extreme discharge of 750,000 sec.-ft., it is calculated that tailwater directly below the embankments will be within 3 ft. of the crest, or to El. 427. Ordinary flood stages will persist long enough to saturate the portion of the embankment downstream from the core. The upstream side will remain saturated to El. 413, and during extreme stages may be saturated to El. 430, the crest being at El. 435.

On account of these conditions, both faces of the embankments must be constructed of materials that will readily drain and avoid slipping. Tests of the spoil from the excavations for the lock and the power house led to the conclusion that, with hydraulic - dredge handling of the materials, it would be entirely feasible to obtain at low cost a very satisfactory impervious core of ample thickness, while producing upstream and downstream faces that would meet the drainage conditions required.

Protection of both slopes of the embankment called for riprapping of such thickness and size of material as to insure against scour or wave action. Present plans contemplate a 3-ft. (minimum) depth of rock on the entire downstream slope; on the upstream slope the riprap will be extended from 13 ft. below normal pond stage at El. 413 to the top.

The crest of the embankment will be 20 ft. wide and is to be capped along its upstream edge with a concrete parapet wall 30 in. high; the parapet will be tight and will be anchored into the fill sufficiently to give it ample stability in case a flood should occur beyond the maximum for which provision is made in the design. At such an extreme stage in the river, the tailwater level would be so nearly that of the pond above the dam that little scour is considered likely on the downstream slope of the embankment should there be an overtopping of the latter.

Construction progress

Actual construction of the Pickwick Landing Dam was started on Feb. 1 of this year. The site is so isolated from rail connections that the extensive tonnages of steel piling and much other material thus far used have been delivered by barge. It is expected that most of the cement, steel and machinery required for the project will be brought in by water. Sources of rock and gravel for the concrete are also available for river transportation. An improved high-

way is being extended to the site from an adjacent paved road of the Tennessee state system. No rail service will be provided.

A modern camp has been built adjacent to the south end of the site. Warehouses, offices, shops and similar facilities have been erected on the flood plain close to the site of the locks.

One of the first construction operations on the dam was to dig a trench 17 ft. deep along the axis of the long south embankment. Beginning at the lock end, the cutoff sheeting was driven in this trench by two portable stiff-leg derrick outfits having 125-ft. booms. Meanwhile, a 16-in. hydraulic dredge had been towed up the river to the site to begin operations on the lock excavation.

The steel sheetpile cells of the cofferdam enclosing the lock will be filled with material from the river channel. Along the stream side of the lock site will be a line of these cofferdam cells paralleling the channel, with wing lines of cells upstream and downstream extending back into the river bank.

In excavating for the power house the dredging will be extended to rock out into the stream to include the north end of the spillway. As soon as rock is exposed over the power-house site, this part of the site will be enclosed with a cellular cofferdam. The lock will be completed by this time, so that the cofferdam enclosing it may be removed and the piling may be re-used in the power-house area. The flow of the river will be confined to a restricted channel during the building of the power house and the adjacent end of the spillway.

Construction of the cofferdams is scheduled for the low-water periods. Overtopping may be expected during the flood seasons, since all cofferdams will rise only to El. 390, which height is exceeded by the natural high water about once every four years. However, it was considered inadvisable to build the cofferdams higher because El. 390 is the average level of the banks and flood plains, and access to the work is cut off when the water rises above this level.

As the third stage of construction, the central or main section of the spillway is to be enclosed by a cofferdam. The power-house intake will previously have been carried up, so that the cofferdam surrounding it may be removed and the stream diverted through the power-house intake.

Concreting plants

Final details of the plants for mixing and placing the concrete have not been announced. The 289,000 cu.yd. required for the lock will be produced by a plant set up on land adjacent to the latter. The power-house intake and adjoining section of the spillway will be supplied from a mixing plant on that side of the river. The entire construction schedule is based on a rate that will permit using most of the construction plant that is now in service at Wheeler Dam.

Personnel

A. E. Morgan is chairman and chief engineer of the Tennessee Valley Authority. C. A. Bock, assistant chief engineer, has direct charge of all TVA engineering and construction. Ross White is general superintendent of construction.

C. H. Locher is construction consultant, and A. J. Ackerman is construction plant engineer. A. L. Pauls, construction engineer, and L. H. Huntley, construction superintendent, are resident at Pickwick Dam.

Recent Taste and Odor Tests of Paints for Water Tanks

By George L. Hall

Division Engineer, Bureau of Sanitary Engineering, Maryland State Department of Health, Baltimore, Md.

TESTS on different types of paint for the interior of water tanks to determine which of them would not impart tastes or odors to the water stored therein have been conducted for a number of years by the state health department in Maryland. The first report of these investigations was made in *Engineering News-Record* in 1931 (April 30, p. 725). At that time seven paints were tested and only one, black paint No. 827, was found completely satisfactory; the general conclusions indicated that most paints having a coal-tar base gave objectionable tastes and odors which increased in intensity when chlorinated water came in contact with them.

Since the 1931 report additional paints have been investigated, and a new procedure has been used in applying lead paints before testing. As in the original investigations, the tests were made with distilled water, laboratory tap water and chlorinated water containing from 0.2 to 2.0 p.p.m. of residual chlorine. Clean metal vessels were painted with the paints to be tested. After the paint dried thoroughly, the water was allowed to stand in the vessels for 15 min. The water was then poured off and tested both hot and cold for tastes and odors.

These tests were made only for tastes and odors imparted to the water, and no attempts were made to determine the respective merits of the paints tested from the standpoint of protection of metal surfaces.

The following paints were found to be satisfactory: (1) gray water-resisting paint S-1777; (2) hydrocide, No. 500; (3) water-tank primer, No. 2081; (4) water-tank finishing coat, No. 2086; (5) lead paint; (6) valdura; (7) no-ox-id "A"; (8) bitumin enamel and primer; (9) inertol; and (10) zinc-dust zinc oxide paint.

Lead paint (5) was applied to the metal container in three coats in accordance with instructions issued by the manufacturer. The priming coat consisted of red-lead-in-oil, mixed with boiled linseed oil, to which a mixture of litharge and turpentine was added. The second coat was the same as the priming coat except for the addition of paste lamp-black with the red-lead-in-oil and boiled linseed oil. The third or final coat consisted of red-lead-in-oil, boiled linseed oil and raw linseed oil to which finely powdered litharge was added dry at the time of application.

The report on paint (9) stated that with 0.5 p.p.m. of chlorine in the water a slight taste, but no odor, was observed in the cold water, and a slight taste and slight odor were noticed in the hot water. The report further stated that these tastes and odors were probably a result of the chlorine used in the water, rather than of the paint itself.

Since the publication of the first tests in 1931, the bureau of sanitary engineering of the department of health has had erected at state institutions one 75,000- and two 250,000-gal. elevated tanks and, in addition, has had painted inside and outside one 100,000-gal. elevated tank. The paints used on the interior of these tanks were No. 827 black paint, the tests of which were reported upon in the original article, and gray water-resisting paint, S-1777, on which the results of the tests are reported above.

In all instances these paints were found to be satisfactory in so far as tastes and odors imparted to the water in the tanks are concerned. None of the other paints mentioned above has been used on any elevated tanks erected under the direction and supervision of the bureau.

The writer wishes to make acknowledgment to Abel Wolman, chief engineer, Maryland state department of health, and to the bureau of chemistry, where the tests were made on the paints under the direction of Dr. John C. Krantz, Jr., chief of the bureau of chemistry.

Modern Construction Practices on Latest Hudson River Bridge

Rip Van Winkle Bridge contractors used a barge mixing plant for both water and land piers, a modified sand-island method for sinking a deep river pier, erected 12,000 tons of steel by deck travelers and distributed pavement concrete through a 1,200-ft. pipe line

FIG. 1—CONNECTING the Rip Van Winkle country of the Catskills with eastern New York and New England, this new bridge, near Hudson, N. Y., provides the only highway crossing of the Hudson River for 25 miles up and downstream.

PROVIDING the only highway bridge crossing of the Hudson River between Poughkeepsie and Albany, a distance of 50 miles, the new Rip Van Winkle Bridge near the towns of Catskill and Hudson, N. Y., is one of the notable large structures completed this year. In design it is not extraordinary in spite of its size, but during its construction several noteworthy practices were followed. For example, in concreting the eight land piers of the east approach an efficient combination of boat mixing plant, industrial railway and pump distribution was worked out; the deep river pier caisson was sunk by a modified sand-island method; 12,000 tons of steel were erected rapidly with two deck travelers; and the deck was poured from a mobile concrete plant consisting of a paver, a belt conveyor and a duplex concrete pump located 1,200 ft. behind the point of pour. The contract cost of the bridge was $2,166,101. Work began in June, 1933, and the bridge was opened July 2, 1935, after a construction period that included two of the worst winters in recent years.

At the bridge site the valley is about 5,000 ft. wide between high bluffs. In this valley the navigable river channel follows the west bank and is separated from a narrower back channel along the east bank, adjacent to the tracks of the New York Central Railroad, by a marshy island some 1,600 ft. wide. The type of structure selected for these conditions consisted of ten 330-ft.-span deck trusses from the east bank across the island and a through cantilever bridge with an 800-ft. main span and 400-ft. anchor spans over the navigable channel. The cantilever bridge provides a 142-ft. clearance for navigation over a width of 765 ft.

Tall steel towers on low piers (El. +16 to +25) support the spans. Of the fourteen piers, seven are on piles; five of these are on the island, while the other two are immediately east of the main cantilever span. The bridge provides a 30-ft. roadway consisting of an 8½-in. concrete slab with a ½-in. monolithic wearing surface. The approaches aggregate 3,700 lin.ft. and include some rather heavy cuts and fills. Spurs connect with state highways, which parallel the river on either side.

Difficult foundation problems on the Rip Van Winkle Bridge were confined to the east pier of the main cantilever span. This pier was located practically at the center of the river in 20 ft. of water and was to be founded on rock at a depth of about 70 ft. A compressed-air caisson was therefore required (at least to permit an inspection of the rock bottom). However, soundings revealed that the river bottom presented a sloping profile, which would complicate landing the caisson in a truly vertical position at the start of the work. To overcome this difficulty, it was decided to level the river bottom by dumping fill material to about El. —10, and then to drive a steel sheetpile enclosure within which the caisson could be started. The sandfill not only permitted the caisson to be started on a level support, but it also served to resist the exterior hydrostatic head on the cofferdam when the enclosure was unwatered. This plan differs from the artificial sand-island method only in that the "island" is not built up above the water surface.

A sketch of this pier construction is shown in Fig. 4. The detailed procedure was as follows: after placing of the fill, temporary timber piles and bracings were installed around which the sheetpile enclosure was driven. This cofferdam was then pumped out in so far as was possible, and the steel cutting edges were set. Working-chamber forms were then added, and at the same time the working chamber was filled with well-tamped soil. Installation of reinforcing steel was followed by the placing of concrete up to 6 ft. above the cutting edge. Tweve hours later a second pour brought the concrete to about 10 ft. above the cutting edge. The outside forms were then removed and the cofferdam was flooded. The bracing was removed, and the wales were lowered about 18 in. and rebraced against the concrete caisson. The cofferdam was then pumped to about El. —2, after which the first 16-ft. lift of the caisson was poured. Following the second 16-ft. lift, the caisson was dredged until it sunk to a point where its top was at El. + 5, and a new 16-ft. lift was added. This operation was repeated until the cutting edge reached solid hardpan at about El. —90. The working chamber was then filled with tremie concrete, after which the dredging wells were pumped out and filled with concrete placed in the dry.

The method proved unusually satisfactory. At no time was it necessary to do any unbalanced dredging to bring the caisson back to plumb.

None of the other piers presented any unusual points of interest. Those on the island consisted merely of concrete pedestals on piles, while the other river piers were built in timber-braced steel sheetpile cofferdams, which had to be

excavated only to about elevation —20.

In considering the foundation concreting problem as a whole, it was evident that a floating plant would be necessary to take care of the four piers in the river. Some means, therefore, was sought to utilize this floating plant for the piers on the island. The scheme finally worked out was to build a pile-supported dock on the west side of the island to which the concrete boats could be moored. From this dock industrial tracks were laid along the center line of the bridge (Fig. 2). Concrete was chuted from the concrete boat to a hopper on the dock from which it was loaded into bottom-dump buckets on flat cars. These cars, traveling the length of the track along the bridge center line, delivered the concrete to the piers, where crawler cranes lifted the buckets into the forms.

FIG. 2—CONSTRUCTION OPERATIONS centered at a dock and storage yard on an island that divides the river into a main and a back channel. Note industrial railway connecting concreting plant at the dock with all land piers, and also the start of steel-erection operations on the left side of the island.

Steel erection

Use was also made of the dock by the steel erector, who centered his operations at this point since materials were brought in by boat. Erection was begun at the pier at the west side of the island. The steel tower was set up on this pier, and one of the other towers was temporarily used as falsework (Fig. 3), to permit erecting enough of the first island deck span to support the traveler. This initial erection was done by a 90-ft. boom guy derrick on the ground. This derrick also erected another guy derrick on top of the steel work with which the traveler was assembled. The traveler moved east, erecting the deck spans by the cantilever method, light steel falsework bents being placed at panel point 4 (about 25 ft. beyond center) in each span. When this traveler had erected the deck spans to the east abutment, it was dismantled and trucked around to the west end, where it started on the erection of the anchor arm of the main cantilever bridge.

In the meantime another traveler had been set up on the west island pier and worked west, erecting the two deck trusses, the east anchor arm and half of the main cantilever span. Closure was made in the center and was aided by eight 300-ton hydraulic jacks on each of the main piers. Steel falsework bents were used under each panel point of the anchor arms. No falsework was used under the main span.

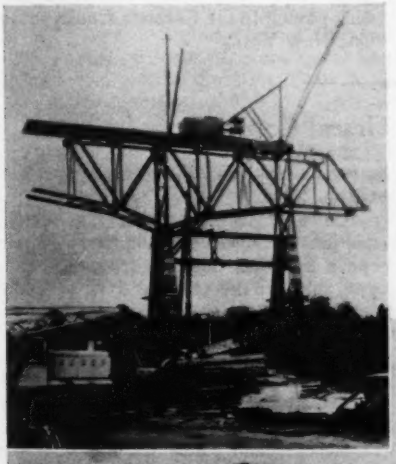


FIG. 3—STEEL ERECTION by traveler derrick was begun in about the center of the 5,000-ft.-long bridge (left) and proceeded both ways. The main 800-ft. span was erected by the cantilever method without falsework during a period when the river was packed with ice.

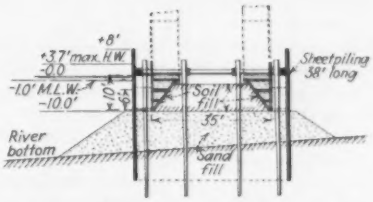
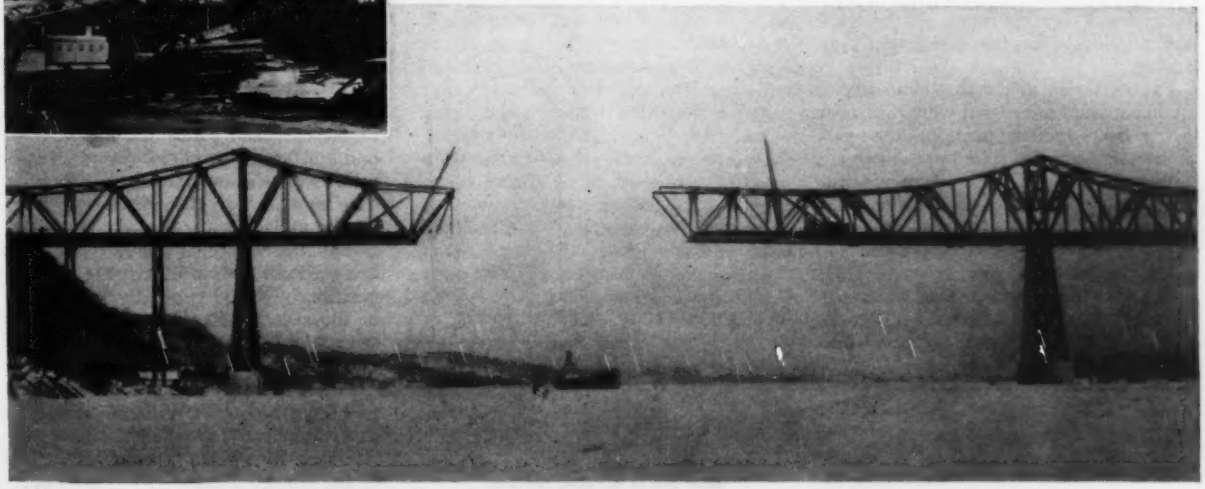


FIG. 4—MODIFIED artificial sand-island method used in sinking the caisson for the main river pier.

Deck concreting

As much interest attaches to the concreting of the deck of the Rip Van Winkle Bridge as to any other element of the construction program. The reason lies basically in the adaptation of the concrete pump to such operations. Instead of laying an industrial rail track or a truck runway over the floorbeams and stringers out to the concreting



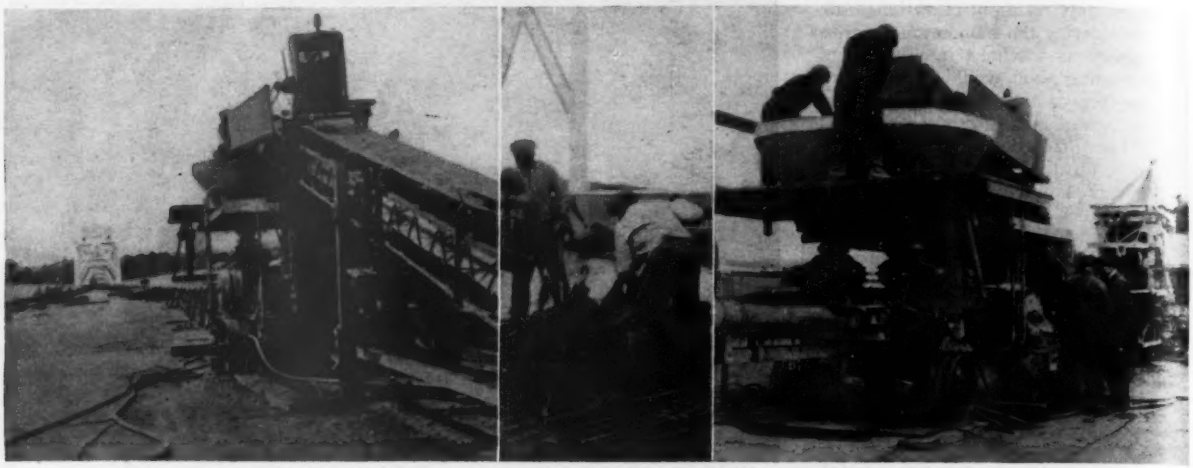


FIG. 5—DECK CONCRETING was carried out by an equipment combination consisting of paver, belt conveyor and 7-in. duplex concrete pump, located some 1,200 ft. behind the point of pour on slab that had cured seven days. Concrete of a slump of 1 to 2 in., as delivered to the pipe line, was spread on the deck with the aid of an electric tamping screed.

point, the procedure developed permitted all equipment to be operated on the compelted concrete slab. By making the pipe line long enough, the concrete was always given seven days to cure before the mixer and pump moved up to it.

As shown in Fig. 5, the equipment consisted of a standard 27 E paver, discharging onto an inclined belt conveyor 25 ft. long, which dumped the concrete into the twin hoppers of a 7-in. duplex concrete pump. These three items of equipment were coupled together and moved forward as a unit. Aggregate and cement were batched at a railroad siding at Hudson, N. Y., three miles away, and trucked to the paver as on any road job.

The equipment was set up about 1,200 ft. behind actual pouring operations. At the start of work in the morning the discharge end of the 7-in. pipe line was placed at the far end of the day's pour. Each day's pour was 246 ft., or three expansion-joint units. As pouring proceeded, the pipe line was successively shortened. Steel reinforcing mats were brought in by boat to the island and distributed along under the bridge by industrial rail cars operating on the track laid previously by the foundation contractor.

Paving began at the east abutment of the bridge and proceeded westward over the entire viaduct section, the east anchor arm and 200 ft. out onto the main cantilever span. The equipment was then moved to the west bank of the river, and the pavement was poured from the west abutment eastward to closure.

The concrete mix specified was 1:2:3½, with a maximum of 5½ gal. of water per sack. This gave a concrete of 1- to 2-in. slump, and this was vibrated into place with an electric screed. Control cylinders averaged 3,000 lb. after seven days.

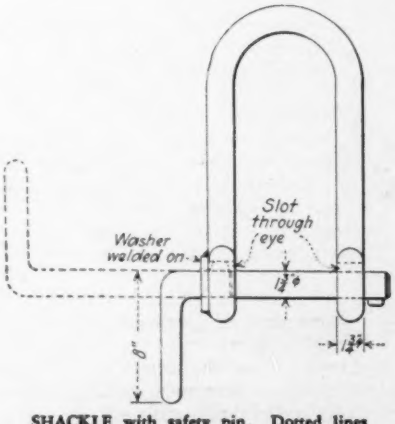
The contractor was unusually well pleased with the operation of the equipment, and work went ahead steadily from beginning to end. At the completion of each pour the concrete pipe line was cleaned out by inserting a charge of sawdust. When this had pushed the mass of the concrete out, the pipe line was directed over the edge of the bridge and flushed clean with water.

Personnel

The Rip Van Winkle Bridge was constructed by the New York State Bridge Authority under the direction of Frederick Stuart Greene, superintendent of public works of the state of New York, and his assistant H. O. Schermerhorn. The bridge was financed through the sale of Bridge Authority bonds to the Reconstruction Finance Corp. Tolls will be charged commensurate with those on the Mid-Hudson Bridge at Poughkeepsie, which is also under the supervision of the Bridge Authority. The bridge was designed by Glenn B. Woodruff in 1930, before Mr. Woodruff became engineer of design for the San Francisco-Oakland Bridge. The general contractor was the Frederick Snare Corp., New York, which built the foundations with its own forces. The steel erection was sublet to the Harris Structural Steel Co., New York, and the deck paving to the Corbetta Construction Co., New York.

Safety Shackle Pin Adopted at Grand Coulee Dam

A NEAR ACCIDENT on the Grand Coulee Dam project, when a bolt fell from one of the shackles used in placing sheetpiling, has led to invention of a safety shackle pin, which was adopted immediately because it operates more quickly than the ordinary pin and cannot fall out.



SHACKLE with safety pin. Dotted lines show pin in retracted position.

As shown in the acompanying sketch, the pin of improved design has on one end a lug much like the front side of a gun, and on the other end is a handle formed by bending the pin itself into a right angle. The pin is retracted by grasping the handle and turning it into the raised position, shown dotted in the accompanying sketch, in which the lug can be drawn back entirely through one of the eyes and partly through the second. A stop provided by a washer welded on the outside of the eye after the insertion of the pin serves as a keeper and prevents the pin from coming all the way out. As these shackles are used chiefly for lifting, the working position of the U generally is as shown in the sketch. Thus gravity ordinarily keeps the handle in the lowered safety position.

Credit for application of this idea goes to (Pete) G. C. Willson, cofferdam superintendent for the Mason-Walsh-Atkinson-Kier Co., contractors on Grand Coulee Dam.

AN ENGINEER'S RECOLLECTIONS

By JOHN F. STEVENS

Consulting Engineer,
Baltimore, Md.

·XII·

Modernizing Operations of the New Haven Railroad

First large railroad valuation undertaken—Executive interests center in expansion schemes rather than in meeting new operating problems—Operating schedules and methods bound by traditions

In the following article Mr. Stevens returns to comment on his railroad work after touching on some elements of his work on the Panama Canal. During the two years here covered, 1907-1909, he was in work of a radically different character from that covered in his recollections of his earlier railroad work. Chronologically, the period here discussed precedes that covered in Mr. Stevens' discussion of Jas. J. Hill's railroad invasion of central Oregon (*ENR*, June 27, 1935, p. 917). This article was written before the recent financial difficulties of the New Haven Railroad were made public. —EDITOR.

WHEN I had returned to New York after severing my connection with the Panama Canal in 1907, it was my intention to visit Europe before taking up engineering again. I had never been able to make such a visit, and a short rest with a complete change of environment after two years of exacting labor seemed desirable.

But on arriving at New York, and before landing from the ship, I was met by an emissary of the New York, New Haven & Hartford R.R., who told me that the president of that company requested me not to make any disposition of my future services until he had an opportunity to confer with me; and as I was under no obligation to any party or company in that respect, and as I had known him for some years, I readily agreed to his request. Shortly thereafter I was asked to meet him at the Hotel Touraine in Boston, which I did.

At that meeting he advised me that the plans of his company contemplated taking over the control of the Boston & Maine R.R., in which company it was a large stockholder, and that such plans were practically completed. As a consequence a change in the presidency of the Boston & Maine would be made, and he asked me to accept the position.

I hesitated to commit myself to the proposition, as it involved the abandonment of the plans of my wife and myself for our long desired trip to Europe. But as both she and I were originally New England folks, and had many relatives in that section, and as I thought that I had a fair knowledge of the transportation problems of New England I finally consented to accept his offer, which was financially very attractive.

Railroad valuation undertaken

But almost immediately there appeared to be a prospect of some delay in the fruition of the plans which the New Haven had made for the Boston & Maine, and I was asked to come to New Haven pending such delay to organize a force to make a systematic detailed valuation of the steam railroad properties of the New Haven company. As such delay was confidently asserted to be likely of short duration, I undertook the work and, incidentally, carried it through to completion, it being, I think, the first work of such nature ever attempted by any of the railroads of the United States.

The work proved to be much more complicated than I had anticipated, and required a comparatively large force of engineers to complete it. Every item of physical property of the company which was involved in steam transportation was counted, classified and listed, and a proper value, based upon reproduction costs, was put upon it, such value being determined by the length of time that it had been in service with a fair allowance for depreciation, where depreciation was justified by the nature of the item. The result showed, as it has since in the case of other railroads, that the road was not overcapitalized, but held property in itself which in value represented every share of its outstanding stock. Its financial troubles arose mostly from unwise investments at excessive cost in outside properties in an effort to monopolize all transportation in its area, and in a less degree from the expenditure of large amounts of borrowed funds in so-called improvements on its lines which neither produced additional revenue nor reduced the expenses of operation to any appreciable extent.

However, as the delay in the principal matter continued, and as I had gotten well along with the work of valuation, I was asked to accept, temporarily at least, the position of vice-president of the New Haven road, to remodel and modernize the operating department of that system; and as such a move seemed logical I undertook the work.

My ideas up to that time of the New Haven railroad's position, financial and otherwise, were like those of the great majority of other people; that if there was a railroad in the United States that stood on a solid, immovable financial basis it was the New Haven. Its stock and other like obligations were regarded as only less sacred than Holy Writ, and, as the common saying went, its stock certificates were kept between the leaves of the family Bible.

But it was not long before I began to get somewhat of an insight into the real condition of affairs on the railroad, and it soon became apparent to me that unless the situation could meet with some miraculous change it would be a question of keeping the road's property off the financial rocks much more than that of assuming further liabilities in another railroad that was staggering along 25 years behind modern methods of administration and operation. As time went on I realized that the far-reaching plans of the New Haven board were not destined to be executed, but as I had become deeply involved in the general and detailed matters of operation, and as the necessity daily grew more pressing to effect economy without materially impairing the service to the public I kept at work, without, however, any hope of much improvement with the financial handicap under which the road was laboring by reason of its unwise investments.

Innovations produce benefits

It was possible, however, to make some changes in methods, and by the introduction of some new blood into the personnel of the operating organization to bring about more modern ways of doing things, some of which innovations resulted in much benefit to con-

ditions. W. G. Bierd, whom I had left as manager of the Panama R.R., joined the operating staff as general superintendent, and to his thorough knowledge of the details of the then modern methods of operation were due many of the reforms which were made possible.

Cooperation from the rank and file of the personnel was very hard to secure, for, to speak plainly, certain very vital matters seemed to rest entirely in the hands of the labor unions, to whom the demands of its members were of much more importance than was the welfare of the railroad company. There were possibly several reasons for the existence of such a situation. One reason, I think, was the quite apparent lack of what may be called fellowship between the official staff and the so-called rank and file. As an illustration of how one employee expressed it: I rode the engine on one of the limited trains one evening from New Haven to Boston. The engineer looked at me several times but said nothing. On leaving the engine I complimented him on the smooth run, and he then said, "This is Mr. Stevens, the new vice-president?" I said "Yes," and he said, "I appreciate very much your riding with me. I have been running an engine on this road for nineteen years, and you are the first executive who ever stepped upon my engine, or I believe, ever spoke to me."

Conservatism in its most unyielding observance was then and likely is still a very marked characteristic feature of the New England temperament, and being born and bred a New Englander myself, I think that I am a qualified judge.

It was almost as difficult to make a 7-min. change in the schedule of a passenger train, when such a change would result in a reduction of expenses without impairment of service in the slightest, as it would be to amend the constitution of the United States. And I venture to say that at that time, at least, the exactions of the New England traveling and shipping public were more onerous than were those of any other section of this country. It was hard for the public at that time to realize that the era of golden days of the New Haven railroad had gone, possibly never to return.

At that time the gross revenues of the road were about equally divided between passenger and freight. The schedules of passenger service especially were intricate, and had from long experience been built up into an elaborate structure. Broadly speaking, based fundamentally upon limited main-line trains, next on expresses, then on semi-locals and lastly on pure locals, the changing of the schedule of any one of the upper brackets necessitated changes to a greater or less extent all along the lower lines. And any proposed change, however small, met with strong public opposition, so much so that on one occasion it looked as though a special session of the Legislature would be called to prevent it.

Freight rates below cost

The New Haven railroad system had been built up through years by gradually combining some 38 different corporations. Many of these small railroads, when formerly operated as independent companies, cut and slashed freight rates in fierce competition, and the result was in many cases that some rates became permanently fixed much below the cost of service. During my time with the New Haven it was as impossible to raise these rates to a living basis as it would have been to move Rhode Island over into Connecticut. We Yankees are a stubborn lot. Loading freight at Lowell as late as three o'clock in the afternoon, and unloading it on the docks at New York the next morning, at a rate of about $18 per car, including transfer and steamship service, were excellent ways to lose money, and lots of it.

Energies wrongly directed

The official staff of the road was, generally speaking, made up of good material. There was, however, a decided lack of coordination as between the different departments which were supposed to be working for the common good. While thoroughly honest and conscientious in their methods, some of the members of the staff had drifted into a laissez-faire state of mind, and they resented any criticism of present procedure or suggestions as to betterments. Mr. Mellen, the president, was a brilliant personage, possessed of an active and versatile mind, which was entirely devoted to the amplification of the New Haven system by ventures which I believe he thought to be essentially sound. There can be no doubt but that all his efforts were made with the view of strengthening the position of the railroad and making its securities more valuable. That subsequent events proved that his methods were erroneous and reacted rather disastrously upon the road and its owners does not in the least detract from the honesty of his motives.

And in all of his policies, I think, it is generally conceded that Mr. Mellen was supported, even when their initiation did not come from the same source, by a high financial power in the affairs of the railroad, which power could have wielded the blue pencil at any time. The meetings of the board of directors which I attended left no doubt in my mind as to the exact situation in that respect. Some of the criticisms which were leveled at Mr. Mellen after the New Haven had gotten into financial plight, as to his being solely responsible for its condition, were unjust, and in instances cruelly so. In a way he was the victim of circumstances.

Mr. Mellen was not an operating man by training or preference. Being intensely occupied by what are generally but erroneously considered the larger problems of railway administration, the vital functions of carrying on the operation was perforce left to subordinates who were inclined to let things drift. In other words, his head was in the clouds and his railroad was on the ground. In other times and under different conditions his policies and acts might have met with success. But with the then inflamed state of the public mind toward railroads in general; with what may be called the hostile attitude of the national government toward corporations; with the precarious condition of the economic life of New England as a manufacturing district, by reason of her location as affected by the competition of more favored sections of the country; and by the certainty of immediate and more stringent national regulation, the policies of the railroad were foredoomed to failure. That such failure was caused by the acts of any one individual cannot be truthfully asserted by any one who had knowledge of the facts that governed the commission of such acts. The board of directors was made up in a majority of hardheaded, successful business men, with whom conservatism was proverbial, and the policies of the road were presumably in their hands.

But while I realized long before I left the service that the rosy outlook which was shown to me when I went with the road was nothing but a fanciful dream, I could not see my way clear to leaving, although I well knew that I was aboard a sinking ship. Some of the results of changes in methods, organization and personnel gave sufficient encouragement to induce me to hope that possibly further improvement might be made, enough to tide affairs along until they could be put on a better basis. But as time went on this faint hope came to appear improbable of realization.

True situation not realized

In connection with the financial mess which the road had gotten into, it was to me rather remarkable how little the general public and even the stockholders realized the true situation. Some months after I had left the New Haven certain financial interests in New York interviewed me as to my opinion of the value of New Haven stock. Why they considered my opinion of any value I do not know, but I gave it. I said the stock would go to around 30 and stay there for a while. The parties immediately countered by saying, "Why, we have a lot that cost over 100." I said, "Well, if it was mine, I would sell and write off my loss," the stock then being 60 or above. Some years later one of them said to me, "If we had taken your advice, it would have saved us some hundreds of thousands of dollars." I only remarked that if they thought that

my opinion was of no value they shouldn't have asked for it.

By consulting market quotations for a long period of years after that time one may find that I was not far wrong in my opinion of future values.

Rolling stock needed

One serious handicap under which the road was laboring was that it had an entirely insufficient amount of freight equipment of its own, in fact much of its local freight was being handled and apparently had been handled for years with the cars of other roads. This of course piled up an excessive per-diem debit charge which only ceased or became much lessened by the purchase and delivery of a lot of cars a short time before the cessation of dividend payments. Much of the freight motive power had been allowed to deteriorate until, after a careful investigation, I reported to the president that the percentage of freight engines in bad order was so high, and increasing so fast, that in six or eight months we would not be able to haul any through fast freights at all. A large modern engine repair shop had only recently been completed at Readville, Mass., but on the plea of cutting expenses it was only partially equipped with tools and therefore was of little use. After some persuasion I got the approval for the expenditure of funds to complete the equipping of the new shop with necessary tools, and in a few months the engine situation was very materially improved, and consequently the service.

Supplies wastefully handled

The store and material department was being very wastefully handled. Supplies were being issued on standard requisitions at regular intervals without any need whatever for them. I had a survey made of supplies on hand at different stations. These supplies had been issued as a matter of schedule at stated periods. One station agent on the Shore Line Division had brooms enough for eight years, another a certain kind of blank forms for twenty-five years, and so it went with all kinds of supplies. As a result, our inspector shipped back to the general storehouse eight car loads of unneeded supplies in three days. Iron and steel scrap had been allowed to accumulate until it had become an eyesore. It was picked up, classified and sold.

Pension list enlarged

Many of the division operating officials were old men, probably efficient in their day and according to the standards of those times, but not having the faintest comprehension of modern methods of railway operation and cost keeping. On my first trip over one of the divisions I was accompanied in my car by the superintendent and several of his staff, all elderly men. As usual the most prominent feature of the landscape near a town was the graveyard, as New Englanders call it. The line of conversation to which I listened for a while was, "Bill is buried over there; Jim died in such a year and is buried in such a place." No talk of tonnage, car loading, empty haul, track work, etc., etc., until I broke in by saying, "I have heard aplenty about dead men, isn't there any live man on this division?" A dead calm broken only by myself prevailed from that time on until I got off that division.

When we arrived at division headquarters, a gentleman dressed in a stiff white shirt (with a diamond prominently displayed) and a cutaway suit, who proved to be the chief clerk, met me and anxiously asked what he could do for me. I replied that he could tell me what all those idle box cars were doing up in the yard when the road was so short of cars to move local freight, and the silence deepened. At another station on the same division I noticed a large empty box car in good repair, standing near the station. On asking the agent why it was allowed to remain there out of service, I was told that it had only been there a day or two. I replied that the soil thereabouts must be very fertile, as the grass and weeds had grown up until they entwined the axles. And so it went. I fear that I did not make myself very popular.

I cite these instances to indicate that an expansive view of finance coupled with ability to borrow money cannot alone successfully run a railroad.

On my return to headquarters from inspection of the various divisions, the pension list was considerably enlarged. At one important station I had noticed a fine looking old gentleman, dressed apparently for a tea party, strolling around with a gold-headed cane. I asked who he was and what he did, and was told that he was the station agent, and that he came down every day for an hour or two. I put his name down as a candidate for the pension list, and then discovered that he was a brother-in-law of J. P. Morgan. He was not pensioned. Louis Brandeis' statement in those days, or even later, that the railroads were wasting a million dollars a day was far too conservative.

Position with B.&M. declined

When it became apparent even to Mr. Mellen that the plans which had been made for taking over control of the Boston & Maine bore slight signs of fruition, he asked me to go to that road as vice-president, as he said that he felt assured that the presidency of it would come along to me later. But I had seen far enough into the real situation to confirm my belief that nothing of the kind could happen and therefore declined the offer, which I thought was made largely to induce me to remain, as I had repeatedly told him plainly what I thought of the situation.

At the time when the federal government brought suit against the directors of the road, long after I had left the service, I was retained for the road by the legal firm of Sullivan & Cromwell to investigate the acts of the board of directors during the years gone by, in regard to operation, service, etc. I found nothing radically wrong other than failure to keep up with the march of progress, but much to commend; and it was remarkable how well the long-past passenger service compared in schedule and reliability with those of the time; in fact, some of them 25 years before were faster. The government suit was settled out of court, and my report was never completed.

Electrification begun

An interesting improvement was carried out while I was with the road, the electrification of the line from Woodlawn to Stamford. This was, I believe, with the exception of the Baltimore & Ohio through the Howard Street tunnel in Baltimore, introduced in 1895, the first heavy electric traction of standard railroads to be installed in the United States, although that of the New York Central was placed in service about the same time. As such installation was in a way an experiment, there were mistakes to be corrected and difficulties to be overcome before satisfactory operation of trains was practicable.

The work of installation was under the charge of the engineering department, and was finally carried out very successfully by it. For several months after the first attempt to handle the service by electricity the operating department had plenty of trouble, but finally the new system worked smoothly, and some years later it was extended from Stamford to New Haven. Electricity was installed in place of steam to eliminate the smoke nuisance in a densely populated district, and in a way was compulsory, but I have never been able to ascertain that it resulted in any economy in operation, and doubt that it did.

New mission undertaken

My career with the New Haven railroad was ended finally by my acceptance of a mission tendered to me by my former chief, Jas. J. Hill, which provided me with not only a reasonable excuse for resigning, but also for giving service again to that remarkable man, if only for a comparatively brief period of time. I therefore tendered my resignation as vice-president, which after some discussion with Mr. Mellen was accepted. I knew that he rather resented my leaving at that time, but there was nothing further that I or anyone else could do to help the situation, and I could not remain. I think that I was fairly popular with the rank and file of the operating department by that time, but I was quite aware that a dis-

tinct sigh of relief went up from some members of the staff, who, like the frog in the pool, only wanted to be let alone.

In after years the railroad, under Mr. Pearson as president in collaboration with Mr. Buckland as chairman of the board, was modernized in its operating facilities and placed upon a fairly safe financial basis. Mr. Pearson undoubtedly gave his life to the service of the road, and his early passing was a loss to the railroad world, for he was a man of marked ability in the field of transportation, an indefatigable worker and a sturdy friend. Since his passing the affairs of the road have been administered by his successors with ability and discretion, and it is now fully up to the exacting modern requirements of the service.

Earth Pressure Tilts Pier of Grand Coulee Bridge

Unusual mishap to steel cantilever bridge, nearing completion below Grand Coulee Dam, throws further light on treacherous sliding tendencies of glacial material

K. S. Brown Photo

GENERAL VIEW of the Grand Coulee Bridge nearing completion, with dam-building operations going on in background.

MOVEMENT of a concrete pier while supporting one-half of a 950-ft. steel cantilever bridge has presented engineers on the Grand Coulee project with an interesting foundation problem. The pier in question is under the east end of the permanent highway bridge across the Columbia River just below the dam site. Assembly of structural steel carried on simultaneously from each end of the bridge was just about to meet at the center of the main span when the east pier, a concrete monolith 150 ft. high resting on a granite foundation, began to tilt riverward. The top of the pier has tilted 9 in. from its original position by the time emergency measures could be taken to arrest the movement. The cause of the tilting and the method of completing the steel structure are described in the following. Previous mention of this bridge and a drawing appeared in *ENR*, Oct. 25, 1934, p. 519.

The relation of the pier to hillside and to foundation rock is made apparent by the accompanying drawing. The root of the trouble lies not so much in the angle of slope in the bank as in the fact that underlying the surface layer of gravel, which ranges up to 20 or 30 ft. deep, there is a deposit of exceedingly fine material—probably of glacial origin—which has a strong tendency to slip and slide when once disturbed. This same formation has given much trouble in the large slides above the west end of the dam, and its sliding tendency is manifest also in the pile of spoil excavated from the west cofferdam, where material in a high dump has continued to move slowly until it flattened to a 5:1 slope, without even then arriving at the angle of repose.

During the past summer the contractor had started excavation along the east bank of the river on a bench cut for a railroad spur that was to pass under the east end of the highway bridge between piers 1 and 2. No excavation immediately under the bridge would have been necessary, however, because engineers of the Bureau of Reclamation, knowing of the underlying clay and foreseeing risk to the bridge from disturbance of the slope beneath it, had required the contractor to build a railroad trestle several hundred feet long under the bridge. This trestle was put in before any work on the bridge piers was done and was to serve in lieu of a bench cut that would have disturbed the slope between the piers.

Subsequent events have proved that the high degree of instability in the underlying clay would not permit excavation of a bench cut even up to the ends of the existing trestle. On Aug. 12, while the bench cut being excavated toward the trestle was still several hundred ft. away, deep cracks were observed along the hillside both up and downstream from the benching operations. It is to be noted that the work which caused this cracking did not load the slope with additional material brought in from some other source, but rather that equilibrium was disturbed merely by re-arrangement of the existing loading.

Within a week or ten days after the first movement had been observed and at a time when the total length of the benching operations was only about 1,000 ft., deep cracks, some as much as 14 in. wide, were found along the river for more than one-half mile. These surface cracks appeared on both sides of the highway bridge and extended as much as 500 ft. from it on the side *away from* the benching operations. That this disturbance extended out into the riverbed at least at some points was proved by the evidences of distress shown in the east pier of the contractor's bridge with which the bench cut was to connect.

On Aug. 23 it was discovered that this deep-seated earth movement toward the riverbed had set up a thrust against pier 2 of the highway bridge, enough to tilt its top toward the river about 5 in. Benching operations were stopped immediately after this discovery, and as quickly as possible two expedients to check the pier movement were put into effect: (1) a 50-ton jack was placed in the gap between the approaching ends of each of the cantilever arms; and (2) two 1¾-in. cables with turnbuckles to take up slack were fastened to connections welded into the shore end of the lower chords in each of the two anchor-arm trusses. These cables were carried inshore to a deadman consisting of two 36-in. steel girders 72 ft. long.

In addition to being held by the dead load of the cantilever and anchor arm which rests on pier 2, the span is permanently bolted into the concrete and its reinforcing; thus the cable on one end of the steelwork and the jack on the other had the advantage of a lever arm of almost 200 ft. in setting up resistance against further rotation about the pier base. Although the tilt was only 5 in. at pier top on Aug. 23 when discovered, by the time the remedial measures had been put into effect on Aug. 25 the tilt had increased to 9 in. This was not a steady movement; 3 in. of the additional tilt occurred in one day. However, after the jack was made operative on Aug. 25 the tilting stopped, and no more had occurred up to Oct. 10 when the job was visited by a staff representative of *Engineering News-Record*. Fortunately, the movement of the pier was precisely parallel to the bridge center line, so that there was no distortion of the steel framing.

After the tilting movement had been stopped it was decided that, since the concrete pier rested directly on granite into which the foundation had been excavated from 2 to 3 ft., there would be no serious menace to the pier if it could be

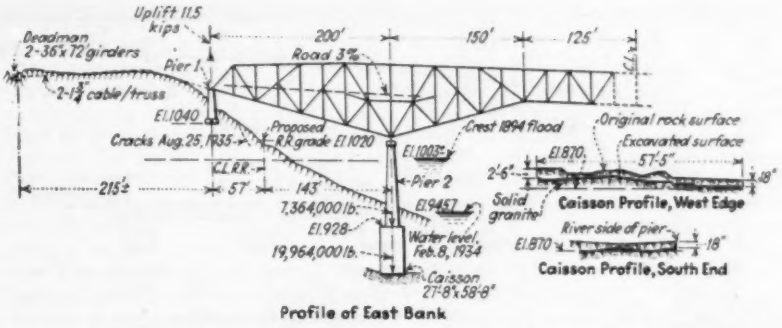
prevented from further tipping. Hence completion of the steel structure was continued, and plans were laid for putting the bridge in service during strengthening of the pier.

As the hot weather season had passed before final connection of the central span was effected, it was possible to take up the entire 9-in. shortening of the 550-ft. center span caused by the movement of the pier in the expansion joints by relatively simple changes. Chiefly this was by lengthening the slot at both ends of the suspended span in which the pin connection is to move, to compensate for contraction and expansion. These cuts plus utilization of the maximum play allowed by the expansion slots made it possible to complete the steelwork as originally fabricated and without any other changes in the structural members. However, in so doing the full amount of the allowance for expansion was taken up. Thus, in order to allow for expansion in warmer weather, some movement of the pier in the line of restoration to its original position must be effected before the hot weather of next season arrives.

As the pier was cast as a reinforced monolithic structure without horizontal joints, it is believed that the entire pier has tilted as a unit, rotating about the base of the westerly face as an axis. Several methods of restoring the pier and strengthening it to resist a repetition of the tilting movement have been discussed, but none had been finally adopted up to the middle of October.

Whatever program is decided upon will include means for preventing movement of the small concrete pier under the end of the anchor arm. Unlike pier 2, pier 1 is not founded on rock. It was poured in forms which were merely set in a pit excavated on the slope of the bank. Because the shore end of the anchor arm is firmly bolted down to pier 1 to take care of a maximum uplift of about 5 tons in each truss, the pier is a vital part of the bridge as a whole.

The bridge construction has been carried on by contract (steel erection by J. H. Pomeroy, San Francisco) under direction of the U. S. Bureau of Reclamation, with R. F. Walter as chief engineer, Denver, and F. A. Banks construction engineer, Grand Coulee Dam.



ELEVATION of east bank, piers 1 and 2 and half of the steel cantilever span of the Columbia River bridge at Grand Coulee Dam.

Modernism in Bridge Design Reflected in Rigid-Frame Span

By Mogens Ipsen
Consulting Engineer, Rockford, Ill.

WHEN it became necessary to replace an old truss bridge in Krape Park, Freeport, Ill., after it had collapsed, it was decided to attempt modern treatment of an engineering problem. A study of types of bridges led to a conclusion that a rigid concrete frame best fitted the requirements. The bridge, started as a CWA project, was completed in the fall of 1934. Relief labor was used on the project after CWA was discontinued.

The design was made for a pile foundation, based on experience but without the benefit of accurate borings. In case the subsoils encountered were poor, it was intended to build the structure with three hinges and analyze it as a statically determinate structure for deadload and volume changes. After removing the falsework, the hinge at the center of the deck was to be closed with concrete and the structure then treated as a rigid frame with hinges at footings only.

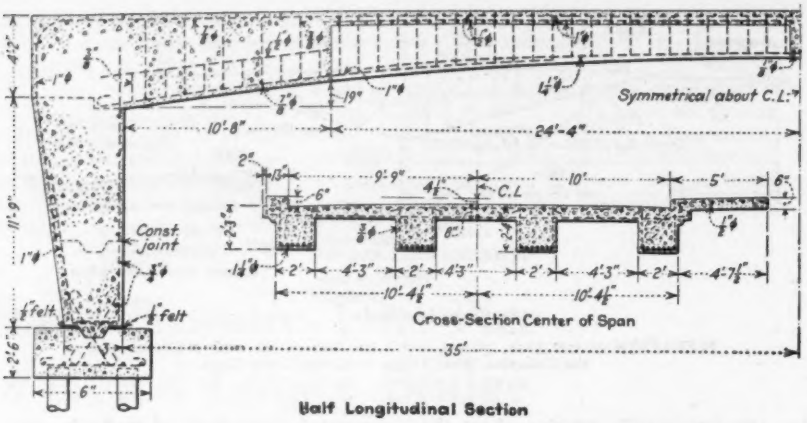
Good foundation made this procedure unnecessary, and the bridge was analyzed and built as a two-hinged arch, or so-called "rigid frame." A rock ledge slightly below the elevation chosen for the footings was found and used at one end. At the other end the footing was built on 22 vertical piles driven into the gravel bottom. A small difference in height of the end walls was not important and consequently was disregarded.

Design specifications of the state highway department of Illinois were followed, with the usual H-15 live load. In addition to dead and live loads, the analysis included volume changes of the deck and some allowance for horizontal settlement at the footings. Maximum stresses, which were considered conservative, were kept within 1,000 lb. per sq.in. in the concrete and 18,000 lb. per sq.in. in the reinforcement.

A roadway surface 19 ft. 9 in. wide was provided with a 5-ft. sidewalk on one side supported by a cantilevered slab. The bridge has a clear span of 70 ft. Maximum depths are 2 ft. 4 in. at the crown and 4 ft. 9 in. at the springing, or 1/30 and 1/15 of the clear span, respectively.

The center of the deck is ribbed,

MODERN ARCHITECTURAL LINES, applied to a rigid-frame concrete bridge at Freeport, Ill., were planned to emphasize the structural design.



RIGID-FRAME CONCRETE BRIDGE in which a portion of the deck near the abutments is of solid section, while the rest of the deck is of ribbed construction in the interest of reduced dead load.

while end walls and the outer portions of the deck are of rectangular sections. Ribs are tapered from a width of 2 ft. 0 in. to 4 ft. 3 in. in a distance of 12 ft. 2 in. The advantage of the ribbed section in the center portion of the deck is that it reduces dead load and the resulting stresses. In 70-ft. spans and longer, dead-load stresses constitute a major part of the total stresses. This is particularly true of dead loads near the crown. Dead loads near and in the abutment cause small or no stresses, so that rectangular sections may as well be used, since they facilitate placing of both reinforcement and concrete near the corner of the frame.

In the deck, construction joints were used at the end of the ribbed section, and also horizontally below the deck at the corner. In the end walls a construction joint was made slightly above the average water level. Concreting was stopped at this joint while the cofferdam was removed. Some hinge action was provided in the construction joint at the top of the footings. The key and groove construction, as shown, transmits horizontal shear and is reinforced with inclined bars crossing at the joint plane. To prevent transmitting moment across the bearing between footings and walls, a ½-in. felt strip was used outside the groove. It was believed that a hinge at this point was preferable, though perhaps not necessary, to insure that no moment would be transferred from the frame of the bridge to the foundation. A perfect hinge without bending resistance is undesirable, however, because it is difficult to hold the end walls in perfect vertical alignment before the deck concrete is placed.

The mid-ordinate of the longitudinal camber was 7 in. in a length of 79 ft. While scarcely noticeable, this camber gives a graceful line to the bridge. The curb produces a shadow line which distinctly divides the side elevation into two parts, the roadway curb and the frame deck. By introducing a light open guard-rail, this functional line, which continues the line of the roadway and approach across the bridge, assumes its rightful position of importance. This treatment is characteristic of modern design.

To emphasize these necessary structural lines and make them part of the ornamentation of the bridge, other lines are introduced, such as the vertical offsets in the wings of the retaining wall, and fins terminating the hand-rails, preventing too sharp a contrast between the vertical lamp-post and the horizontal deck and protecting these posts from collision.

Engineering direction

The bridge was built for the Freeport Park District, of which Charles Demeter is president. R. K. Eastman gave valuable architectural assistance. The plans were prepared and construction supervised by the writer.

Letters to the Editor

Terminology in Soil Mechanics

Sir—Professor Housel's letter in your issue of Sept. 19, 1935, p. 408, has just come to my notice. Discussions of this sort are of great value. Soil mechanics is a comparatively new branch of technology, and we have a long way to go and much to learn. It is at present passing out of its early stages, and a number of fundamental principles and concepts have become well established. With these concepts, a certain terminology has developed, and workers in this field are now confronted with the task of keeping clear of ambiguities that are apt to creep in at first unnoticed only to give rise to misunderstandings later on.

As a case in point: I notice that Professor Housel uses the phrase "ultimate shear resistance or plastic limit of the soil." Now, fortunately or otherwise, the term "plastic limit" has already been employed by Atterberg in a different sense, and to employ it now as a synonymous expression for "ultimate shear resistance" is almost certain to lead to confusion later on. I hope Professor Housel will see fit to withdraw his use of this expression. Ultimate shear resistance is sufficiently definite in the idea which it is intended to convey to be quite satisfactory, and it seems hardly necessary that there should be two expressions to mean the same thing, and more especially so when one of them means something else.

I. F. MORRISON,
Professor of Applied Mechanics,
University of Alberta.
Edmonton, Alta.,
Oct. 4, 1935.

Plate Action Vs. Beam Action

Sir—Your issue of Sept. 19, 1935, p. 406, shows a number of concrete beam tests made by the highway department of Oregon, the alleged object being to secure thin floors for overhead crossings. The highway department, not only of Oregon but of many states, and the U. S. Bureau of Public Roads seem determined to utilize beam resistance only and disregard plate resistance. The disadvantages resulting from this unscientific choice may be illustrated by comparison of the Oregon test with ordinary practice.

The beams tested had a depth of 10 in. from the steel to the top of the slab, or about 12 in. of concrete depth from the bottom to the top. The span was about 12 ft. Now a properly supported 12-in. slab is ample for a 30-ft. span under the heaviest highway loading, with less than ½ per cent of steel. Why should our highway departments use such an excess of both materials because of unscientific design and failure to take advantage of the principle of a plate?

Because the plate has three elements of resistance against one for a beam—radial bending resistance, circular bending resistance and circumferential compression—a plate supported on four sides is six times as strong as a beam for the same material under uniform load and four times as strong under a concentrated central load, as may be readily demonstrated by elastic models of celluloid.

The writer has built thin plates of reinforced concrete up to 50 ft. in span for railroad bridges, and a span of 40 ft. is common for highway bridges. Because of the difference in

action, the stiffness of the thin floor supported to act as a plate is nine or ten times that of a slab supported to act as a beam under central load. This is true because of the greater lateral distribution of the load in plate action as compared to beam action.

There is opportunity to reduce the cost while increasing strength and neatness over ordinary and customary practice through proper design of plate construction. Such construction simplifies form work, reduces the quantity of both concrete and metal and greatly reduces the working stresses. Lower working stresses prevent plastic yielding with time and disintegration under frost action, which follows plastic deformation.

Compare the two elements in the composite combination: Steel, relatively uniform, is trusted to but one-third its yield-point value under a testing speed of 4 in. per minute, and but about one-fourth its ultimate. Is concrete, less perfectly elastic, to be trusted with twice the relative proportionate resistance?

Again, temperature stresses are more readily provided for in plates than in beams. Checking and cracking of the concrete is accordingly reduced. Contraction joints every 500 or 600 ft. withstand temperature ranges from 40 deg. below to 100 deg. above zero.

If highway departments are in fact interested in economy and care to save material, it would seem profitable to investigate results that have been secured in plate design and, if they doubt the record, to test plates in connection with beams.

Minneapolis, Minn., Sept. 26, 1935. C. A. P. TURNER, Consulting Engineer.

Bridge-Welding Procedure

Sir—Much credit is due the engineers of the Ohio Department of Highways for the candid manner in which they have presented their adverse experiences in the use of welding (*ENR*, Oct. 3, 1935, p. 472). However simple the problems involved might seem to those highly experienced in the welding of steel-plate assemblies, which have been used quite extensively in all-welded ship construction, nevertheless the fact remains that a large majority of structural engineers and steel fabricators are almost totally unfamiliar with the problems of shrinkage and distortion that must be met and solved in welded constructions.

As pointed out by the authors, the difficulties were due partly to the design of the assembly and partly to the welding procedure used. In only two respects does the writer question the principles set forth by the authors in their recommendations. In connection with one of these, the authors recognize the controversial nature of the subject of peening welds. The other point is with regard to the place where responsibility should rest relative to the planning of the welding procedure that is to be used.

With regard to cold-peening, the following quotation is taken from an article by A. B. Kinzel in the August issue of the American Welding Society *Journal*, the italics being furnished by the writer: "It has been well and frequently demonstrated that the amount of cold work, *produced by shrinkage in cooling or by peening or any other cause*, necessary to produce recrystallization without excessive grain growth implies a critical relationship between the amount of cold work and the annealing temperature, *or heat applied by the subsequent runs of weld metal*." Hot-peening is probably less dangerous than cold-peening when a conscientious effort is made to control the work and the proper type of "slag-shielded" electrodes are used to keep the weld metal above a red heat for perhaps 45 sec. or more after its deposition; but it is extremely doubtful that either hot or cold-peening has a practical application where important joints are involved that must withstand dynamic loading. In the case of hot-peening, there is also a rather delicate relationship that must be maintained between the time of performing the hot work and the temperature of the metal, in order to avoid the creation of adverse metallurgical effects. In this regard reference may be made to the work of Professor Campbell, of the University of Michigan, upon the effects of temperature changes and mechanical working on the grain size and mechanical properties of steel.

It cannot be denied that the peening of welds will accomplish just what is claimed for it in the way of correcting distortions, where conditions can be accurately controlled as in a manufacturing plant. But in the case of joints made in the field to carry dynamic loads, as in bridge construction, the writer considers the use of peening to be a very ticklish operation, to say the least. In spite of the fact that serious damage or loss of life would not accompany the failure of a welded joint in a deck plate, the writer would favor a slightly more expensive welding procedure, rather than to resort to peening of any kind to relieve the shrinkage stresses. When a critical condition is encountered, there is little doubt that by the use of smaller-size electrodes and a greater number of passes, shrinkage stresses can be reduced and physical characteristics improved in general.

Although the engineer must enter into any contract with an open mind toward making any changes in construction procedures that may prove advisable, still it is very necessary, especially in the case of welded construction, for the one who designs the structure and draws up the specifications to outline the procedure of welding definitely, even down to quite minor details, and to provide that it be strictly followed. This is necessary in order to give the contractor a definite basis upon which he can base his bid. Also we are going to have to get entirely away from the erroneous attitude that has been held quite commonly in the past that welding procedure is something to be determined largely by experimenting on the job, leaving the details to be worked out by the operators and inspectors. Furthermore, it is very questionable whether a contract should be let for a welded job until the engineer is reasonably sure that he has outlined a procedure for welding that can be followed successfully without changes of much consequence having to be made during the progress of the work.

Topeka, Kan., Oct. 21, 1935. LAMOTTE GROVER, Office Bridge Engineer, State Highway Commission.

Correction—Welded Girder Test

Sir—I wish to call attention to a drafting error in Fig. 3 of the published report on "Arc-Welded Bridge Girders Tested to Failure," in your issue of Sept. 19, 1935, p. 393. In the diagrams of the welded web splices, the typical field splice has been marked "Shop," and vice versa.

When lack of space made it necessary to omit part of the data that was prepared for this report by George W. Lamb, bridge designer of the state highway commission, who was to have been a joint author, mention of his cooperation in the work was inadvertently omitted. Special acknowledgment is now made of the very valuable services rendered by Mr. Lamb, both in planning the work and in supervising the welding operations and making careful time studies of them.

Topeka, Kan., Oct. 15, 1935. LAMOTTE GROVER, Office Bridge Engineer, State Highway Commission.

Sand-Filter Studies

Sir—The cover of your issue of Sept. 26, 1935, and the article on "Hydraulic Research at Iowa University" showed a photograph of a battery of glass cylinders, filled with sand, for studying the hydraulics of sand filters. This investigation is the first of a series of proposed laboratory investigations into certain hydraulics problems of the sanitary engineer being carried on at the Iowa Institute of Hydraulic Research. This phase of the work is under the supervision of E. L.Waterman, professor of sanitary engineering, of the State University of Iowa. These facts were omitted from the article.

If may also be noted as a matter of interest that a sanitary engineering laboratory, available for the use of graduate students, is being provided in the sewage-treatment plant now under construction at Iowa City. The work will be under the direction of Professor Waterman and Prof. J. J. Hinman, Jr. of the University.

Iowa City, Iowa, Oct. 2, 1935. F. T. MAVIS, Acting Head, Department of Mechanics and Hydraulics.

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EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, C. S. Hill, H. W. Richardson, E. J. Cleary

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Nov. 7, 1935

Machine-Gun Policy

MACHINE GUNS instead of surveyors' instruments now symbolize South Carolina highway activities. One wonders at the need of sudden army mobilization to control highway department operations, operations that have been notable in recent years for their sane management and sound technical direction. Then one recalls the precedents of Louisiana and Georgia and the fierce southern jealousy of predominance in public parade, and the situation becomes clearer. Not much can be done to combat visions of personal sovereignty when they thus arise, except to wait for the common sense of the people to be manifested. Meanwhile, the orderly processes of highway development are checked and transportation suffers. Invariably these eruptions of dictatorial power have upset administrative morale and dulled technical enterprise, and invariably the recovery of both has been slow. It is not difficult to conclude that poor service has been rendered to highway progress in South Carolina.

Pumping Rock

THE PUMPING of pulverized rock from heading to shaft-top is another of the achievements in tunneling that so frequently of late have startled the engineering world. Ingeniously taking advantage of the friable nature of the St. Peter sandstone, contractors on the Twin Cities sewer tunnels adopted pumping as a means of muck disposal, as described elsewhere in this issue; the method quickly proved itself simple and effective. This new step in tunnel driving ranks with other recent notable advances in the art, such as belt conveying through the compressed-air locks at Boston and power tightening of lining bolts in the Midtown Tube at New York. In each of these cases it deserves to be noted that the development in procedure resulted from the contractor's firm faith in an ingenious but untried piece of equipment—at Boston the muck trap in the air locks, at New York the hydraulic wrench, at Twin Cities the rubber-equipped pump that made pumping of the highly abrasive materials practicable. Cascade, Boston, Boulder Dam, Colorado Aqueduct, Twin Lakes, Midtown, and now Twin Cities, represent tunneling achievements that will be long remembered. Rock pumping is the latest chapter of a fascinating serial story of progress.

—and Safety?

PRAISE is always due the engineer who makes a special attempt to utilize the materials in his structures more efficiently than is usual in the ordinary run of work. When he also tries to use those materials in such a way as to enhance the appearance of his structure, added commendation is in order. These thoughts are engendered by an interesting concrete rigid-frame highway bridge completed this year in Freeport, Ill., and described in this issue. Reducing dead load by using rib construction for the center portion of the span while the end portions are solid barrels represents efficient use of materials; not only is the weight distributed more effectively, but the increased rigidity of the end sections places the largest moments where they are more easily resisted, at the same time that the form cost is reduced. The fascia treatment is unusually interesting, and the utilization of a deck overhang to give visual separation of arch and deck function is logical and pleasing. At this point, however, one's admiration of the attempt at architectural functionalism wavers, since a light open hand-rail is used, on esthetic grounds. The certainty that this light rail will not hold a vehicle against going overside makes it seem an alarmingly questionable feature. Were it backed by a curb of substantial height and strength, the light railing might claim to be justified; but in fact the bridge has a curb only 6 in. high, which even the lightest vehicle can easily surmount. It seems fair to ask whether beauty must necessarily be at loggerheads with safety. Can we not have beauty *and* safety?

A Roadbuilding Threat

IN AN EXTRA SESSION sitting less than a day New Jersey on Oct. 25 repealed the sales tax for unemployment relief enacted only a few months previously. Cynical rumor has it that the repeal action was for election purposes and that sometime after Nov. 5 the solons, all doubt concerning their jobs being removed, will reassemble to consider new relief imposts. But the more probable thing is that before new taxes are considered all present department revenues will be examined for money that can be diverted—and of all these the highway department offers the greatest opportunities for plucking. Thus, though action is yet in abeyance, the road taxpayers of New Jersey face the definite threat that the small remainder of highway improvement money will be diverted from its assigned purpose. The situation is a direct challenge to road-users to preserve their right to obtain through improved roads some return for the millions of dollars that they are paying for road service. And the challenge has to be met at once and with a might greater than the usual mouthing of resolutions by road-building associations. Conviction of their wrongs has to be carried to road-users and by them into the state legislature and executive offices. This is the duty of the widespread organizations of the highway industries.

By Wise Direction

JOHN F. STEVENS, in the current chapter of his recollections, indirectly points to conditions responsible for some of the troubles of our railroads. While he speaks specifically of the New Haven—now in financial difficulties that came to light after this chapter was written—he might have found much the same condition on many other railroads. First there was banker domination; a railroad run with an eye to profits for those who handled its securities, rather than to development of a transportation agency that could operate at a profit. And second, there was the inefficiency of personnel that is the usual outgrowth of the first condition. Closely related to the latter is the waste found in any operation carried on by highly unionized trades. And the whole operation was bound up in traditions and practices that were difficult if not impossible to eradicate under the conditions then existing. By close attention to the operating problems of the railroad, by eliminating many wasteful practices

and such of the inefficient personnel as could be disposed of, and by building up the interest of the remainder of the staff, Mr. Stevens was able to take the railroad a long way toward becoming an efficient transportation agency. But there were financial burdens and operating practices beyond his control that have remained, some to the present days. Here again the New Haven is not unique, as any review of the present condition of American railroads will show. Such of their troubles as are due to outside influences cannot be eliminated by one man, but as Stevens demonstrated on the New Haven and a few others have done on other railroads, many internal troubles can be eradicated by wise direction that is more interested in building up an efficient transportation machine than in preserving outworn practices and traditions.

Developing the Tertiary Road

SPEAKING before road officials of the township roads of his state, a prominent state highway engineer said a few years ago that, after absorbing annual road taxes of $12,000,000 throughout a generation, not a road was materially better than when the first dollar was paid out. Every road official who listened could have told a story of identical experience by his own state except for the amount of money involved. Until a few years ago no state had a significant mileage of good tertiary roads or was getting any recognizable investment value from its annual expenditure of tax money on this class of roads. That, in brief, is the story of generations of waste due to a bad system.

A change is now coming about; the township road is becoming an adequate means of transportation, although there are yet major problems of type selection, design and construction that have to be solved and that call for serious thinking and further discussion. At the moment the question is that of progress. A year ago (*ENR*, Dec. 13, 1934, p. 754) a Connecticut official told of the striking development of the third-class highway in his state; how with almost paltry expenditure for each town, but with centralized management and technical direction, a system of tertiary roads useful to all is coming into existence. In the present issue an even more striking revolution of old conditions is described.

The cases of Connecticut and Michigan are not unique. In North Carolina, in Indiana, in Virginia and in Pennsylvania, where town roads have been lifted out of the hands of the townshisp, in different measure but in a positive manner, the same growth of land-service road values is evident. This has in most cases been a fortuitous result of legislation designed to relieve land of tax burden, but the result is none the less significant.

The facts point unmistakably to the necessity for a change in highway administration, one that must be prepared for by public-road legislation and management. As the land tax is more and more felt to be an impost on existence, its reduction will be demanded and granted, and road improvement as one of its chief beneficiaries must be taken out of the hands of local agencies. So far these changes have been impulsive rather than deliberate, and the road engineer has been a minor factor in planning the manner and procedure. It must hereafter be his function to play a directing role, or else he may find burdens laid on him without provision for carrying the extra load.

The latter is what has happened in some of the states that have begun the absorption of township roads. Most often the extra burden has been a demand for increased road service without increase in the funds needed to pay for it. A financing plan on a sound budgetary system of improvements and appropriations must be the basis of every increase in centralization of highway administration, and in this task the road engineer has the knowledge for wise direction of legislative action. His must be the broad outlook on road development as a transportation problem, including the land-service road, but not at the hazard of impoverishing main-traffic-route facilities. This need of wise engineering selection becomes increasingly important at the present time when the land-service road is in danger of being sublimated as a means of work relief by administration influences looking to the number of jobs created rather than to economic transportation service rendered.

Power Plans Changed?

HAS a new spirit entered into the power planning of the present Administration? This question is inspired by some recent happenings, notably the orders to hold up letting of contracts for the major structures on the Passamaquoddy tidal-power project until Maine sets up a special body to market the power. By itself, this event may not appear significant, but when taken in connection with the abandonment of plans to puts a power plant in Grand Coulee Dam, the closer cooperation between the TVA and the electric utilities of the Tennessee Valley, and the efforts of the Rural Electrification Administration to foster rural expansion by existing utilities rather than through the establishment of independent rural power-service agencies, it suggests that the Administration has modified its power plans.

Originally, there were clear indications that the government planned to go into power development on a large scale at several points, regardless of whether the particular region was adequately served with power or could use the large quantity of power that had to be disposed of to make the unit cost of the government's power low. Thus there was a prospect of cut-throat competition, with the government in the unsavory position of doing most of the cutting to make a favorable showing. Now the situation appears to be changing to one in which the government, instead of attempting to control rates through the competition of a complete publicly-owned power system, will use its power to supplement that of the private utilities, exercising control through agreements for the sale or resale of bulk power, and meanwhile using its agencies (such as the Rural Electrification Administration) to develop new markets.

Such a policy is much more reasonable and represents better economics than cut-throat competition. Also, it fits in with national planning, about which the national Administration has said so much. Generally speaking, it is the most desirable power sites that have been developed to date. As the nation's power demand grows, the less economic sites and those which require an abnormally large initial investment, such as the St. Lawrence, must be developed. Here is a proper field for government development or subsidy in a national economy in which all natural resources are developed according to a logical plan.

If the signs now appearing are truly indicative that the Administration is turning toward such a practical application of national planning, they are indeed encouraging.

CURRENT NEWS

Contract for New York Subway Awarded to Rosoff Company

Contract for the construction of the first section of New York City's Sixth Ave. subway has been awarded to the Rosoff-Brader Construction Corp., New York City, on a bid of $5,583,768. The Rosoff company was low bidder on an alternate which provided for the use of excavated rock for improving Rikers Island in the East River. On this alternate the George A. Flynn Co., Pittsburgh, Pa., was second low with a bid of $5,590,787. On an alternate permitting the contractor to dispose of rock in any way he wanted, George A. Flynn Co. submitted a bid of $5,294,287, and Rosoff-Brader Construction Corp. a bid of $5,452,768.

This first section of the subway will extend through the congested underground area from 40th to 47th Streets.

Latest developments in the plans for unification of the several rapid transit systems in the city indicate that the city may be able to raze the existing Sixth Ave. elevated structure in the near future, thereby reducing the cost of building the subway by about $5,000,000.

Clarence D. Howe Named to New Canadian Cabinet

Clarence D. Howe, head of the firm of C. D. Howe & Co., designers and builders of grain elevators and pulp mills, has been named to the Cabinet of Prime Minister W. L. Mackenzie King, new head of the Canadian government. Mr. Howe is to head a new department, probably to be known as the Department of Communications, into which Premier King has announced that he will consolidate the departments of Marine and of Railways and Canals. In this new position Mr. Howe will be in charge of one of the most important Cabinet offices.

Mr. Howe is a naturalized Canadian citizen having been born in Waltham, Mass., in 1886. He is a graduate of Massachusetts Institute of Technology and spent several years in engineering work in this country before going to Canada, first with J. R. Worcester & Co., Boston, and then as an instructor in the civil engineering department of M.I.T. In June 1908 he went to Dalhousie University, Halifax, to become professor of civil engineering, a position which he held until 1913, doing private consulting work in addition, both in his own name and with J. R. Worcester & Co. He specialized in reinforced concrete construction.

Mr. Howe went to Port Arthur, Ont., in 1913 to become chief engineer of the Board of Grain Commissioners of Canada, a position in which he had charge of the design of many large grain elevators in the Prairie Provinces. In 1916 he formed the firm of C. D. Howe & Co., consulting engineers, Port Arthur. He continued to serve the grain board as consulting engineer and in recent years has given much time to world trade studies.

PWA Announces Plan For Operation Of Housing Projects

A WORKING basis for operation of the federal low rent housing projects undertaken by the Housing Division of PWA and additional allotments for the enlargement of the Jane Addams project in Chicago, and the establishment of two new projects have been announced by Administrator Ickes.

Operation of the housing projects will follow two general lines; the first contemplates direct operation by the federal government and the second, operation by existing local public housing authorities, probably through a lease agreement.

The housing division is now developing 49 projects in 35 cities. The housing projects will be put into operation with funds set aside for that purpose, each project having been provided with operating reserves. Rents collected will be paid into the Treasury, operation and maintenance expenses being met from appropriated funds.

An allotment of $5,000,000 for enlargement of the Jane Addams project, Chicago, has been approved by the President. The allotment, taken from old PWA housing funds will be added to the present allotment of $1,500,000 making a total of $6,500,000 available for the project. This additional allotment will make it possible to enlarge the site by about 15 acres and to increase the number of dwellings from 305 to 677 units. The enlarged project represents amendment of the original plan for a West Side project which was suspended some time ago when the housing division felt that exorbitant prices were being asked for the land. Motions to dismiss pending condemnation proceedings against the land once sought for the Blackhawk and a part of the West Side project were made in the Federal District Court on Oct. 30.

Two new projects announced

For the development of new projects in Evansville, Ind., and Enid, Okla., allotments of $1,000,000 and $435,000, respectively, have been approved. A 10-acre site in Evansville, on which are located substandard frame dwellings has been optioned for the project. Tentative plans call for the construction of 200 row houses and flats, mostly row houses as only 80 3-room flats have been specified in the plan. A 6-acre site has been acquired for the housing project in Enid, and tentative plans call for the erection of 90 row houses.

The B-W Construction Co., Chicago, on Nov. 4, was the apparent low bidder on construction of foundations for the $1,500,000 Jane Addams slum clearance and low rent housing project. The bid was $104,890. The apparent low bidder for construction of foundations on the $3,000,000 project at Camden, N. J., was the Turner Construction Co., Philadelphia, who submitted a bid of $105,590.

Geodetic Survey Allotment Found To Be Unauthorized

Official announcement by PWA this week of an allotment of $901,164 to the Coast & Geodetic Survey later proved to be erroneous. The program submitted through the National Resources Committee went to the White House but came back without the President's initials which signify approval. The mistaken announcement that the allotment had been authorized resulted from the fact that the Survey's program was included in a list with other projects that were approved and the exception was not noted.

The Survey had planned to employ 600 engineers and other college-trained men on processing field data previously accumulated in geodetic and coastal surveys at a cost of about $10,000,000. The data is useless unless compiled and published.

Contractor Rejects Seminoe Award Because of Delay

A delay of 62 days, or two days beyond the limit specified in the call for bids, and minor changes in labor regulations, were given as sufficient reasons by the contractors for rejection of the contract for the Seminoe Dam in Wyoming, for which bids were opened by the Bureau of Reclamation last July 22. The contractors, an association of Winston Bros. Co., Utah Const. Co., Morrison-Knudsen Co., Bechtel Co. and Henry J. Kaiser, claim that the long delay in award of the contract denied them the advantages of the low-water period of the river, would throw the start of work into winter construction and would otherwise increase the cost of operations. They point out that the delay of two days beyond the legal limit in awarding the contract allowed the bid bond to elapse and relieved them of further obligation.

The project, to be built on the upper reaches of the North Platte River, is financed from relief works funds. In the original specifications regular PWA labor rates and regulations were stipulated, with an exception being made to permit a 40-hr. week. Minimum wage rates were specified for all classes of labor. After the bids were opened an attempt was made by the relief works administration to apply the WPA wage and labor regulations to the project, which would have required that at least 90 per cent of the labor come from relief rolls. The Bureau of Reclamation fought the proposed changes as impracticable in the sparsely-settled area, and was finally successful in having the original labor conditions restored except for a few minor points, though not until the 60-day award period was passed.

The low bid was $2,194,007. Rather than accept the second low bid of $2,638,073, submitted by J. C. Maguire of Butte, Mont., the Reclamation Service has called for new bids to be opened at Casper, Wyo., on Nov. 26. The principal change in specifications lengthens the time for completion from 950 days, as stipulated in the July 22 call for bids, to 1,150 days.

Unusual After-Shock at Helena Causes More Damage, Wrecking New School

UNLIKE the usual history of earthquakes, the series of shocks at Helena, Mont., included a severe after-shock. Coming on Oct. 31, it completed the destruction of many buildings which had been cracked and wracked by the earlier quakes which began Oct. 3 and included major temblors on Oct. 12 and 18. During the past four weeks several hundred shocks have occurred, sometimes as many as 20 per day, but these were of very minor intensity, and the major disturbance was assumed to have passed. A report of the early damage was published in *ENR*, Oct. 24, p. 588.

Fortunately the U. S. Coast and Geodetic Survey instruments, which were rushed to Helena after the major shock of Oct. 18, got an accurate record of the Oct. 31 shock. These records show that the heavy movement continued for 4 sec., followed by lighter movement for 20 sec. The intensity was 16 per cent of gravity and the dominant period 0.2 sec. The epicenter was in close proximity to Helena, to the northeast.

Supplementing the report on damage published in the earlier issue, additional information has been obtained from H. M. Engle, civil and structural engineer of San Francisco with the Board of Fire Underwriters of the Pacific, who spent several days in Helena (Oct. 22 to 26) inspecting structural damage. Mr. Engle's comments follow:

"Damage to Helena structures that were of inferior or antiquated construction (and there were many of these) was of the usual sort and offers nothing new to the structural engineer. However, in the lower part of Helena, where the damage was probably most severe, was a modern fireproof school not yet occupied which was completely wrecked. This building had a reinforced concrete frame and floors; the tile walls were faced with brick. The construction was at least average and perhaps better—the wreckage cannot be accounted for by the usual alibi of 'poor construction.' Although it can be attributed to poor design so far as earthquake resistance is concerned this is hardly a reflection on the designers, since the design was adequate for normal conditions and conformed to general practice in the Helena district. Previous to these shocks Helena has never been recognized as seismically active.

"A short distance from this school was another which also was seriously affected. In general, the damage consisted of the shattering of tile walls and partitions and the failure of the concrete frame in many places. Columns were cracked below the floor beams, in some cases were crushed and reinforcing bars were buckled. Many beams and girders were cracked and one beam was found to be completely shattered. Another school building, not an old one, with masonry-bearing walls and wooden interior also was wrecked. As usual, school buildings loomed large in the wreckage.

General structural conditions

"Structural conditions in Helena were rather poor, the majority of mercantile buildings being of masonry, bearing-wall type; some were four or five stories high. An impartial appraisal of many of these old structures before the shocks would have condemned them so far as assured safety under normal conditions was concerned. Damage to bearing-wall buildings was the typical result of quakes on such structures; parapets came first, then front walls over show windows and gable walls parallel to interior framing fell out. Some walls collapsed in whole or in part, leaned and bulged out or were badly loosened up with the typical X-cracks in the wall panels. Brick chimneys, as usual, were cracked, shattered or thrown down. The behavior of tall stacks was uniformly poor and such as remain should be removed. Brick dwellings were affected severely, collapse of walls was common and brick veneer peeled off like paper, showing a total lack of anchorage to the wood frames.

"The people of Helena face a serious situation in the rehabilitation of their city. It is no disgrace to admit the inadequacy of past practice in design and construction, but it will be a disgrace if engineers, architects and residents of the district generally fail to profit from their lesson. Rehabilitation to be intelligent must be more than repair: it must include strengthening and additional safeguarding against future shocks."

School foundation not on rock

Additional reports, concerning the wrecked high school, from W. A. Lamb, district engineer, U. S. Geological Survey, state that "it appears that the foundation under the north end does not rest on solid rock, but is built on filled-in material. The central and southern parts are on solid foundation. The structure cost about $475,000 and was a PWA project. Some consider it a total loss, while others estimate it as a 75 per cent loss."

Eastern seaboard shaken

Closely coincident with the renewal of earthquake shocks in Montana, the eastern seaboard from southern New Jersey well up into Quebec and northern Ontario, was shaken at 1:05 a.m., Nov. 1, by a quake believed to have had its epicenter in northern Quebec. The only damage of any importance reported was to track of the Canadian National Railways, about 375 miles east of Cochrane, Ont., where about a quarter mile of track was displaced, ties being pulled loose from the rails. A fissure 250 ft. long and 40 ft. deep is reported to have opened at Lake Menjobaques, near Doucet, Que.

TWO VIEWS of the new Helena high school as it appeared after the Oct. 18 quake (left) and after the Oct. 31 quake.

ANOTHER SCHOOL building whose veneer walls proved inadequate to cope with the earthquake force of 0.16g.

Toronto Tunnel Work Halted By Canadian Government

The new administration of the Canadian Government has halted construction of the new vehicular tunnel under the west channel of Toronto Harbor, for which a $1,000,000 contract was let a few weeks ago to the Dominion Construction Co. The reason given was that the new minister of public works wanted to "review the contract." A new airport was planned for the island that lies to the south of Toronto Harbor, and the new tunnel was to provide a quick route to the airport and other parts of the island. The outgoing administration had promised $1,000,000 toward the cost of the two projects, according to reports, and the city of Toronto was to supply an additional $500,000. The tunnel, 2,000 ft. long, is unique in design, being elliptical in section, 61 ft. wide and 30 ft. high. Provisions are made for a 40-ft. roadway and two sidewalks. It is to be built by the cut-and-cover method.

PWA Funds Freed For New Orleans Sewer Work

A sum of $1,800,000, allotted by PWA for use by the New Orleans Sewerage and Water Board, and subsequently withheld by order of Administrator Ickes when the constitutionality of state laws calling for the reorganization of the board was questioned, was made available for the purchase of the bonds of the sewerage and water board on Oct. 31. The action freeing the money for the purchase of bonds was taken after a careful study of opinion rendered on Oct. 2 by the attorney general for Louisiana. The opinion held that as the contract had been made prior to the effective date of the state law, it was in no way affected by the statute.

The project had progressed to the point where the sum had been placed on deposit in four New Orleans banks for the payment of bonds purchased from the sewerage and water board by the PWA. With the passage of a state law providing penalties for federal activities not authorized by the Constitution, Administrator Ickes instructed the state director on March 7 to sign no vouchers for payment of the bonds. Later the banks in which the money had been deposited were enjoined from honoring drafts or checks of the sewerage board. This caused contractors on the sewer project to suspend work because of non-payment. It was later decided to pay for the work from local funds until such time as the PWA funds were made available (*ENR*, Aug. 29, 1935, p. 312). In addition to the $1,800,000 now made available by the PWA for purchase of the bonds, it is expected that a grant of $770,000 will also be allowed.

SOCIETY CALENDAR

INTERNATIONAL ACETYLENE ASSOCIATION, annual meeting, Cleveland, Ohio, November 12-15.

ASSOCIATION OF WESTERN STATE ENGINEERS, annual meeting, Salt Lake City, Utah, November 13-14.

NATIONAL RECLAMATION ASSOCIATION, annual meeting, Salt Lake City, Utah, November 15-16.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., December 5-6.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Miami, Fla., December 9-12.

WASHINGTON IRRIGATION INSTITUTE, annual meeting, Wenatchee, Wash., December 12-13.

AMERICAN SOCIETY OF PLANNING OFFICIALS, state planning conference, Chicago, Ill., December 12-13.

NATIONAL RIVERS & HARBORS CONGRESS, special meeting, New Orleans, La., December 13-14.

AMERICAN ENGINEERING COUNCIL, annual meeting, Washington, D. C., January 9-11, 1936.

AMERICAN ROAD BUILDERS' ASSOCIATION, annual convention and road show, Cleveland, Ohio, week of January 20, 1936.

EXPOSITION OF CHEMICAL INDUSTRIES, fifteenth annual exposition, New York City, December 2-7. Metals and alloys, plastics and plant equipment will be include among the exhibits.

UNITED ENGINEERING TRUSTEES, announce the election of the following officers: GEORGE L. KNIGHT, president; H. G. MOULTON, and OTIS E. HOVEY, vice presidents; ALBERT ROBERTS, treasurer; JOHN ARMS continues as secretary.

MUSKINGUM VALLEY ENGINEERS CLUB, Zanesville, Ohio, has been organized with the following officers: T. T. KNAPPEN, president; J. F. COBB, vice president; H. W. MANSFIELD, secretary-treasurer.

REA Announces Loans For Seven Projects Serving Middle West and Southern States

LOAN contracts involving $1,274,084, to finance the construction of 1,122 mi. of electric lines serving 4,247 rural customers, were signed Nov. 4 by Morris L. Cooke, head of the Rural Electrification Administration. Of the seven projects involved only one, covering 3 mi. of line at a cost of $6,100, is sponsored by a privately-owned utility. This is explained by the fact that most of such applications are for large projects involving $500,000 or more, according to Mr. Cooke, and therefore require more time for investigation and study.

The largest project to be approved so far is located in Boone County, Ind., and is sponsored by the Indiana Statewide Rural Electric Membership Corporation, developed under a new statute by the state farm bureau. This body is a new form of farmers' cooperative adapted to the business of distributing electricity. Although construction will be carried on by a subsidiary organization known as the Boone County Rural Electric Membership Corporation, the statewide body will provide maintenance, insurance and other services to this and other county cooperatives within the state. The Boone County project embraces 587 mi. of line to reach 2,200 new rural customers. The entire cost, up to $567,926, will be loaned by REA. Proposed rates, subject to the approval of the State Utility Commission, will provide 100 kw.-hr. per month for $4.95, and additional kw.-hr. for 3c. and 2½c.

Project to use TVA power

A second county-wide project will be undertaken by the city of Dayton, Tenn., which now has a municipal power plant and is also purchasing from TVA. It plans to extend service throughout Rhea County by building 38.9 mi. of line to serve 215 farms. The first 100 kw.-hr. will cost $3.50, covering the standard TVA wholesale rate plus a surcharge of 1c. per kw.-hr. to amortize the REA loan of $38,058.

Scotts Bluff and Sioux counties, Neb., will be served by the Roosevelt Rural Public Power District, which will build 220 mi. of line connecting 839 new customers at a cost of $310,000. Power will be purchased from four municipalities which secure it from hydro-electric plants of the U. S. Reclamation Service at Lingle and Guernsey, Wyo. In another section of Scotts Bluff County the Gering Valley Rural Public Power District will erect 47 mi. of line to serve 143 customers at a cost of $65,000. In Miami County, Ohio, the Miami Rural Electric Cooperative, Inc., is borrowing $254,000 to build 193 mi. of rural line to serve 690 farms. The Bartlett Community Light & Power Co., a corporation buying power from the municipal plant in Bartlett, Tex., will use $33,000 to construct 30 mi. of rural extensions serving Bell and Williamson counties.

The only private utility loan is $6,100 to the Central Iowa Power Co. for 3 mi. of new line in Dallas County, Iowa, to serve 50 customers.

Loans cover full cost

In all cases the REA loans cover the full cost of the projects at 3 per cent, to be liquidated in twenty years. No repayment of principal will be required during the first year. Construction will start promptly and relief labor will be used in so far as possible. Equipment loans through EHFA are promised to help build up an immediate load. The Central Iowa Power Co. pledged its general credit as security; in the other six cases, all involving public power distribution, the loans are secured by mortgages on the lines.

Willamette Water Resources Studied by Army Engineers

Investigation of the Willamette River basin in Oregon for the purpose of developing a coordinated plan for control and utilization of its waters in the interest of power, navigation, irrigation, flood control and other purposes, including municipal water supply and sewage disposal, is now in progress under the direction of U. S. army engineers. An allotment of $200,000 from WPA funds is being used for the greater part of the field work. Additional engineering and technical services not obtainable with WPA funds are being secured with an allotment of $25,000 from regular river and harbor funds.

The investigation is in charge of Col. T. M. Robins, division engineer, North Pacific Division, C. I. Grimm is chief civilian engineer and R. D. Goodrich is consultant on flood control. Field work consisting of surveying, mapping and exploration of foundations for dam sites is in charge of Lt. Col. Milo P. Fox, district engineer, First Portland District; H. A. Rands and G. E. Goodwin, principal civilian assistants. The district engineer, U. S. Geological Survey, the state engineer and the Agricultural Experiment Station at Corvallis, Ore., are cooperating.

TVA Type of Development Not Favored in Northwest

Sentiment preponderantly unfavorable to adoption of a Tennessee Valley Authority type of administration for the federal power developments in the Northwest was expressed at the hearing conducted by the Pacific Northwest Regional Planning Commission, Portland, Ore. This was one of seven such hearings held in different cities in the four states embraced by the commission: Oregon, Washington, Idaho and Montana. The commission is charged with the responsibility of reporting on the future of the Columbia Basin in a way that will be "helpful in determining the type of organization which should be set up for the planning, construction and operation of certain public works in that area."

Several alternatives were pointed out at the opening of the meeting: (1) operation by a public corporation, (2) placing all the power enterprises under a single operating unit such as the Bureau of Reclamation or the Corps of Engineers, (3) place each project under the control of the bureau constructing it, (4) create an authority for the entire Columbia Basin similar to the Tennessee Valley Authority. The Commission's report on Columbia Basin development should be available soon.

Examinations Now Required Under Nevada Registration Law

The 1935 session of the Nevada State Legislature passed an engineer's registration law, bringing all who practice any branch of the profession, other than military engineering, under the provisions of the act. The act provided for a Registered Professional Engineering Board, to be appointed by the Governor and fixed Oct. 1 as the deadline for registration under the "grandfather" clause.

George W. Malone, recently resigned as state engineer, is chairman of the board. Approximately 125 Nevada engineers have been granted certificates as registered professional engineers. Applicants who have applied after Oct. 1, 1935, will be required to pass such examination as may be prescribed by the board. Since the law includes all branches of engineering—civil, mining, electrical and mechanical—a uniform certificate, as registered professional engineer, without specific designation, will be issued to all applicants meeting the requirements of the board under the act.

Mexico Plans Irrigation Dam In Rio Grande Valley

Plans are being drawn for a large dam on the San Juan River for the Mexican government's irrigation project which will reclaim about 150,000 acres of land in the Lower Rio Grande Valley, situated opposite the irrigated and developed area on the American side of the river. The construction of the dam and canal system will involve an expenditure of about $8,600,000. The site of the proposed dam on the San Juan River is a short distance above where it empties into the Rio Grande. The structure not only will be used to conserve the flood waters of that stream but will help to prevent overflows of the Rio Grande along its lower course.

Montana Earthquakes Centered Ten Miles From Helena

Preliminary seismograph observations of after-shocks of the Montana earthquake of two weeks ago, reported by the U. S. Coast and Geodetic Survey, show that the movements in Helena were largely vertical. Subsequent study of seismograph records obtained at Sitka, Alaska, and Bozeman, Mont., shows the epicenter to be within 10 mi. of Helena, instead of from 30 to 40 mi. away as believed at first. This is in agreement with the observation of predominantly vertical movement at Helena, as in the region above the focus of an earthquake the direction of motion is mainly vertical, while at a considerable distance horizontal movement becomes important.

When the strong-motion instrument was set up at Helena, with an automatic release to start its operation on the occurrence of any strong shock, the instrument did not start automatically, as the release was set to be actuated by horizontal movement. The vertical-component instrument showed the movement to be strong in the vertical direction. F. D. Ulrich, in charge of the seismograph work at Helena for the Survey, then developed a starter which would respond to vertical motion.

Land Condemnation For Housing Will Go To Supreme Court

The federal government's right to condemn private property for low cost housing will be determined by the U. S. Supreme Court, which consented, Oct. 28, to review the Louisville, Ky., case, in which the government's power to condemn land for this purpose was contested.

Secretary Ickes expressed the opinion, this week, that there should be a permanent federal housing authority vested with the authority that PWA now is trying to exercise in building low cost housing projects. It was pointed out that such an authority could receive all the disputed questions, such as local taxation of government owned property, in order to help local communities pay for police and fire protection and schools. To clear up this specific point, PWA is now drafting a bill for introduction in Congress in January. Secretary Ickes said that he favors perpetual financing of low cost housing projects from a revolving fund established by federal appropriations and thereafter maintained by the proceeds of amortization. He emphasized, however, that a subsidy of 45 per cent is necessary to bring rents within the capacity to pay of the lowest income groups. Such rents must cover service of the 55 per cent loan and 3 per cent interest amortization, operating and maintenance charges.

Comptroller General McCarl's decision prohibiting payment by the federal government of a lump sum, in lieu of taxes, for municipal services on PWA's low rent housing projects is a matter that Congress can cure, in Administrator Ickes' opinion. PWA proposed to pay for such services out of rents but, according to the Comptroller General, this does not escape from the well-established rule that the federal government or its activities may not be taxed. PWA projects in a number of cities and several "greenbelt" projects which are being established by the Resettlement Administration are affected by the ruling.

Work on Conchas Dam Gets Under Way

Preliminary work on Conchas Dam on the South Canadian River in San Miguel County, N. M., was begun on Oct. 16. The work is being done under an allotment of $4,500,000 which was made to the Corps of Engineers in August. The project, which is to be under the charge of Capt. Hans Cramer, is designed to prevent flood losses and provide water for irrigation and for the city of Tucumcari, N. M., and Amarillo, Tex. A new engineer district has been set up at Tucumcari and Capt. Cramer has been transferred to this post from Memphis, Tenn.

The dam is to be located at the junction of the Conchas and Canadian Rivers about 28 mi. northwest of Tucumcari. It is to be an earth-filled structure about 2,600 ft. in overall length and 230 ft. high. About 800,000 acre-ft. will be stored behind the dam. The entire project calls for an expenditure of about $9,000,000 (*ENR*, Aug. 1, 1935, p. 168).

Denver Proposes to Build Sewage Treatment Plant

After considering alternative plans for complete, as against partial, sewage treatment work, Denver, Colo., has decided to start out with partial treatment. The city has engaged Black & Veatch, Kansas City, Mo., to design primary treatment works, planned for the addition of either chemical precipitation or activated sludge process. The capacity of the plant will probably be 60 m.g.d. A sewage bond issue of $2,000,000 was authorized by referendum vote on May 21, 1935.

The choice of method of sewage treatment has been affected by the uncertainties as to the plan which would be adopted for delivery into Denver of the additional water supply which will be diverted from the Fraser River through the pioneer bore of the Moffat Tunnel. It was formerly proposed to deliver this water into Dry Creek, and thence to the South Platte River, 20 mi. above Denver. On Sept. 10 a bond issue for a conduit to carry the Fraser River supply from the proposed delivery point on Dry Creek into Denver, and filtration en route, was approved. (*ENR*, Sept. 12, 1935, p. 357.) The city was then able to decide upon the type of sewage treatment to be used.

At present the sewage in Denver is discharged into the South Platte River below the city, and subsequently diverted for irrigation. The plan for completely treating this sewage provided for chemical precipitation, rapid sand filtration, and use of the final effluent for irrigation. Filtration was proposed as a safeguard against amoebic dysentery. Complete treatment of some kind may yet be required to meet local conditions, and the demands of the State Board of Health.

New York City Votes Funds For World's Fair Work

The New York City Board of Estimate has adopted a resolution authorizing the expenditure of about $200,000 for preliminary work for the World's Fair which is planned for 1939. The resolution adopted by the Board of Estimate provides that the site for the park be the Flushing Meadows Park and whatever contiguous lands that need to be taken in addition. The city park department is to turn the site over to the committee in charge of the fair for two years, or more, depending upon the length of the fair, after which the committee will cede the site back to the city. The funds which have been authorized will be used to prepare maps showing the boundaries of the site, at a cost of about $75,000, and maps for drainage and grading of the site at a cost of about $125,000. This latter figure is also to include maps for the rehabilitation of Riker's Island.

A non-profit corporation with more than 100 prominent New York men as incorporators has already been formed. At present it is planned to open the fair on April 30, 1939, and to continue it for six months in that year and then to reopen it in 1940 for another half year.

Total cost of the project has been estimated at about $40,000,000, which would include all buildings and land necessary. The cost of the added land that will be necessary for the fair is expected to be close to $5,000,000.

Correlation of Building Codes In Hands of New Committee

The first step of the American Standards Association after taking over the national building code work dropped by the U. S. Department of Commerce has been the organization of a committee to attempt to clean up the present confusing conditions in the building code field. More rational and economical standards for building construction are sought by the committee which was set up on Sept. 17, with Rudolph P. Miller, consulting engineer, New York, as chairman, and George N. Thompson, chief, section on building codes, National Bureau of Standards, as vice-chairman. The new committee will supervise the work of several sectional committees which will be assigned to develop building standards and specifications, to be made available to municipalities.

An executive committee of this larger committee has been appointed to develop and submit a plan of procedure by Nov. 15. Members are J. Andre Fouilhoux, American Institute of Architects; William P. Capes, American Municipal Association; W. F. Austin, Associated General Contractors; Edward W. Roemer, Building Officials' Conference; W. E. Mallalieu, National Board of Fire Underwriters, and Messrs. Miller and Thompson.

Davenport-Rock Island Bridge To Be Studied by Committee

A seven-man commission has been appointed to represent the city of Davenport, Iowa, in a meeting with a similar committee appointed from Rock Island, Ill., to study plans for a tunnel under the Mississippi River, or a bridge, between the business districts of the two cities.

A bridge from Bittendorf, Iowa, to Moline, Ill., about three miles upstream from the proposed Davenport-Rock Island crossing is nearing completion and will be opened to traffic early this month (*ENR*, Sept. 19, 1935, p. 415).

The Davenport committee is headed by F. F. Betty. The other members are C. Von Maur, E. P. Adler, N. H. Tunnicliff, Dan Keeler, Al J. Thomas and R. L. Getty.

Members of the committee representing Rock Island have already been named.

Johnson Becomes Chief Engineer For The City Of Pittsburgh

Henry D. Johnson, Jr., was appointed on Oct. 16 as chief engineer of the department of public works of Pittsburgh, Pa., to fill the vacancy created by the resignation of Charles M. Reppert on Aug. 31. Mr. Johnson was associated with the city division of bridges and structures from 1926 until 1933 as construction engineer. Since 1933 he has been in charge of the division. In addition to his work in the division of bridges and structures, Mr. Johnson has had the direction of all unemployment relief activities since 1930. After leaving Northeastern University in 1922, Mr. Johnson spent two years with the Jones & Laughlin Steel Corp., following which he was field and office engineer of the Pittsburgh district for the Dwight P. Robinson organization on electrical power transmission improvements.

Bridge Maintenance Methods Discussed At Railway Engineers' Meeting

RAILWAY bridge maintenance, particularly under the conditions of the past few years, was a prominent subject at the annual meeting of the American Railway Bridge and Building Association, held at Chicago, Oct. 15-17. A report on inspection of bridges and buildings pointed out that maintenance deferred or neglected may result in conditions that call for prompt attention, so that there is need for more frequent and thorough inspection. In the work of repair or strengthening there are many opportunities for the use of welding, this method being convenient, effective and economical.

Such applications of welding were emphasized also in a report on the welding of iron and brass pipe lines for air, gas, water, steam and oil. Both electric and gas welding are successful, and are used according to local conditions. This report recommended the adoption of welding in general bridge and building work, and also recommended the training of men as welders. In this way a permanent or special welding gang may not be necessary, as a steam-fitting or water-service gang can be made up as required. In fact, one railroad requires its plumbers, steamfitters and water-service men to be capable of handling gas, thermit and electric welding. In discussion it was noted that the Southern Pacific is making a point of training many of its younger men in this way, for the purpose of having at least one competent welder in every bridge gang.

Use of penetrating oils

The maintenance condition applies also to bridge painting, as neglect may result in rapid deterioration. A report on the removal of rust and scale preliminary to repainting showed that there is a trend toward the use of penetrating oils as a substitute in part for the ordinary methods of sand-blasting or the use of hand and power operated scrapers, chisels and wire brushes. The efficiency of sand-blasting depends upon the use of clean sharp sand, but some railroads use any sort of local sand. The report recommended that before any extensive repainting, consideration should be given to the use of oils or special preparations for loosening rust and scale. This not only saves time and money for cleaning, but also retards further corrosion and thus lengthens the time between paintings.

Substructures and foundations need to be included in the inspections, but periodical or routine inspections must be supplemented by special examinations after storms or floods. The construction of highway bridges near existing railway bridges creates a situation that calls for special attention, since the effect of the newer structure on the currents and stream bed cannot be predicted.

Bridge floors for highway bridges over railroad tracks were the subject of a lengthy report, covering a variety of constructions in concrete (with and without surfacing courses), timber, solid steel decking and steel grid with concrete filling. For wooden floors, it appears that laminated construction is being used increasingly by state highway departments, but while some designs have the planks (on edge) laid longitudinally, others place them transvesely of the bridge. Fire hazards and the use of blast plates under the floors to protect them from erosion by engine exhausts were also discussed. Among the bridge papers were the following: "The Application of Welding to Railway Bridges," by A. R. Wilson (Pennsylvania R.R.); "Increased Life for Pile Trestles," by I. L. Simmons (Rock Island Lines); "Construction of the San Francisco Bay Bridge," by George W. Rear and H. I. Benjamin (Southern Pacific Ry.) and "Trends in Bridge Design, Erection and Maintenance," by C. Earl Webb (American Bridge Co.).

Treated timber in buildings (which does not seem to make much progress) and pumping equipment for water stations were the subjects of other reports, together with a paper on the installation and maintenance of track scales, by C. R. Letzkus (U. S. Bureau of Standards). Officers elected include: president, T. R. Strate, division engineer, Chicago, Milwaukee, St. Paul & Pacific R.R.; secretary, C. A. Lichty, Chicago, Ill.

Use of Subsidies Suggested For Rural Electrification

Planning of rural electrification on a comprehensive scale hitherto unthought of, based upon the supplying of current in rural territory on a non-profit basis through state and federal subsidies, is suggested by Sen. George W. Norris, Neb., in a letter addressed to Morris L. Cooke, Administrator of the Rural Electrification Administration. Pointing out that France plans to have 100 per cent farm service by 1940 and Sweden supplies 40 per cent of its farms with electricity, the senator believes that the fact that the electric industry in this country is 90 per cent private should not stand in the way of progress in the rehabilitation of American agriculture. He requests REA to assemble basic data for such a comprehensive plan and to give an opinion as to its feasibility. Information is also requested on what steps REA is taking to utilize current produced by irrigation, flood control and navigation projects now being built with PWA funds.

Replying to Senator Norris, Mr. Cooke points out that REA planning has so far been based upon self-liquidating projects only, without subsidy, and that it is hoped to treble the present number of electrified farms on this basis through reductions in costs. He agrees that more comprehensive service in rural areas must eventually come, and promises to provide the necessary facts to permit drawing plans for the future.

First announcement of a government loan for rural electrification was made on Oct. 23 by the Rural Electrification Administration, which has allocated $700,000 to the Imperial Irrigation District, located in the Imperial Valley, Calif., to construct 497 mi. of transmission and distribution lines serving 1,500 families. At the same time it was revealed that $295,000 had previously been allocated, though not announced, to the Southern Sierras Power Co. for a project which would also be located in the Imperial Valley.

New Jersey Section of AWWA Organized Last Week

Efforts to organize the New Jersey Section of the American Water Works Association were culminated on Oct. 30 when 85 waterworks men met at Rutgers University, New Brunswick, to elect officers and to adopt by-laws. New Jersey members have hitherto been associated either with the New York or the Four States (Eastern Pennsylvania, Maryland, Delaware and southern New Jersey) sections, depending on their geographic location. The newly formed group was authorized last year by the national association to start separate organization proceedings under the assumption that this would develop closer correlation of the activity of the large number of waterworks men who have similar problems and who are under the jurisdiction of the same state laws. Assistance and cooperation with existing New Jersey agencies identified with the planning and conservation of the state water resources is planned. It is also felt that the local state group can be of aid in furthering the adoption of tenure laws designed to prevent political manipulation and unmerited discharge of municipal waterworks employees.

Roster of new officers

The officers elected were: chairman, S. F. Newkirk, Jr., Elizabeth; vice-chairman, C. D. Moon, Haddon Heights; secretary-treasurer, P. S. Wilson, Glen Ridge; Trustees, G. F. Wieghardt, Weehawken; W. R. Connard, Burlington; J. A. Carr, Ridgewood; representative to the A.W.W.A. board of directors, William J. Orchard, Belleville.

Micro-organisms in water

The technical session of the meeting featured an illustrated talk by Dr. T. E. Nelson of the department of biology, Rutgers University, and a member of the New Jersey Water Policy Commission, who used photomicrographs to show the many varieties of taste and odor producing organisms in water. A single drop of water magnified one thousand diameters and projected upon a 3 ft. square translucent glass screen, enabled the speaker to show the characteristic forms and activities of many living microscopic inhabitants of reservoirs. Some studies directed toward a correlation of conditions of environment with the abundance of *synura* and *dinobryon* indicated that these organisms increase when water temperature is lowered; also that the numbers increase shortly after rainfall.

Little Rock, Ark., Amends Application for Water Funds

The Little Rock, Ark., authorities have filed with the Washington office an amended application for a PWA grant and loan to construct a water reservoir and pipeline, asking $3,990,000 additional for construction of a distribution system. The city's original application for $3,500,000 was approved tentatively by the President in the amount of $3,080,000 but the initial allotment was held up on the ground that the Arkansaw Water Co. would benefit from the loan and grant through its contract with the city. A resolution authorizing the amendment was passed by the city council and forwarded immediately to Washington.

Deadline Advanced As Program Fails To Meet Quota

(Washington Correspondence)

WITH the latest reports showing employment of 1,543,185 persons, Administrator Hopkins pushed forward from Nov. 1 to Dec. 1 his deadline for employing 3,500,000 men. The Administrator also indicated that by that date all federal funds for direct relief will be cut off.

The character of the WPA program is gradually assuming definite form. Roads comprise about one-third of the total projects undertaken. Parks, playgrounds and other recreational facilities account for 20 per cent of the total, while schools and public buildings make up 13 per cent. White collar projects amount to 11 per cent of the total, and water, sewerage and other public services reach 9 per cent; all other miscellaneous projects account for 14 per cent of the total.

Employment only 44 per cent effective

With its employment drive only 44 per cent effective, because of the spotty character of WPA's operation, it is believed that the Administration is trying to divert public attention to other features of the works program. Other agencies, such as the CCC and the Resettlement Administration, have been instructed to publicize more extensively the work they are doing. The CCC was a going concern before the works program was launched and accounts for 31 per cent of the employment in the works program up to Oct. 26, but the other agencies account for very little in the line of creating employment.

Responsibility now on state officials

It is emphasized by officials that the state WPA administrators are responsible for getting the works program under way. This is especially true since, during the past two or three weeks, the jamming up which held up the works program has been broken with the cooperation of the Comptroller General. By abandoning the slow practice of allotting funds for specific projects and by approving a vast amount of projects from which state administrators could select those which can be undertaken most quickly, up to the limit of funds actually allotted to the state, the WPA program has advanced considerably.

Industry asked to help

While President Roosevelt is calling upon private industry to match the employment created by the government's works program, Mr. Hopkins frankly admits that private employment of 3,500,000 men would not put an end to the employment problem. Just how much added employment will be necessary cannot be determined because available estimates of unemployment are not adequate and definite data probably will not be available until the act providing for unemployment insurance becomes effective.

Mr. Hopkins insists that the support of unemployables is no longer the responsibility of the federal government and that it will be necessary to revert to the 1929 status, but with a new conception of pubilc responsibility for people. It is his belief that the states and communities are able to raise $500,000,000 for relief annually.

Personals

ROBERT B. B. MOORMAN has resigned his position as assistant professor of civil engineering at the University of Mississippi to accept a similar position with the University of Missouri.

GERALD F. LOUGHLIN has been appointed Chief Geologist of the U. S. Geological Survey. Dr. Loughlin succeeds DR. TIMOTHY W. STANTON who is retiring. Dr. Loughlin entered the service of the Geological Survey in 1912 and frequently has served as geologist in charge of the division of mineral resources.

JOSEPH A. ROONEY, Brooklyn, N. Y., has been appointed associate engineer in charge of survey operations on the flood control survey being carried out by the Corps of Engineers in the recently flooded New York and Pennsylvania areas.

ROLAND E. ANTHONY, Philadelphia, Pa., has recently been appointed associate structural engineer, Bureau of Public Roads, U. S. Department of Agriculture, at Frankfort, Ky. He was formerly assistant district construction engineer with the Pennsylvania department of highways.

RUSSELL ALGER HALL has been appointed co-chairman of the division of engineering and is in charge of the civil engineering department at Union College, Schenectady, N. Y. He came to Union College from the University of Illinois in 1930, where he had been an assistant professor in the College of Engineering.

MORRIS S. JONES, formerly assistant chief engineer of the Pasadena water department, has been appointed chief engineer and general manager, succeeding Samuel B. Morris, who resigned Sept. 1 to accept a professorship at Stanford University as executive head of the Department of Civil Engineering.

HERBERT S. WALTERS, state highway commissioner of Tennessee, resigned Sept. 19, and has been succeeded by BRIGGS SMITH, division engineer at Knoxville. Mr. Walters graduated in civil engineering from the University of Tennessee in 1920 and has been with the state highway department most of the time since. He is president of the Hamblen National Bank of Morristown and head of the Walters & Prater Construction Co.

RALPH D. MACY has been appointed as chief engineer of the New Jersey Public Utilities Commission. He will fill the position held by Philander Betts, who retired last year. Mr. Macy, who graduated from the engineering school of Yale University, was chief engineer of the Emergency Relief Bureau in Washington during 1934. Mr. Macy has spent a number of years in public utility work.

C. I. GRIMM, chief civilian engineer of the Bonneville project on the Columbia River, has been promoted to the position of head engineer under Col. T. M. Robbins, division engineer. In his new position he retains general supervision of the engineering at Bonneville, and, in addition, engineering supervision over all other projects in the division. A. E. MCKENNETT succeeds Mr. Grimm as head engineer in the second district office of the division under Col. Charles F. Williams. Mr. McKennett was formerly senior engineer under Mr. Grimm on the Bonneville project.

Obituary

EDWARD LEE RICE, 70, building contractor, died Oct. 30 at his home in Shelbyville, Ky.

JAMES LAURIN, contractor of Montreal, Can., died there on Oct. 30 at the age of 72. Mr. Laurin graduated in civil engineering from Laval University, and was then engaged in railroad engineering for several years. He was next associated with J. E. Vanier, consulting engineer, Montreal, a post he held for twenty years, leaving to found the firm of Laurin and Leitch, general contractors.

FREDERICK S. MOODY died at his home in San Francisco, Calif., on Oct. 27 at the age of 71. From 1920 to 1923 he was a member of the State Board of Harbor Commissioners, California, and after resigning that position served as state highway commissioner.

STANDISH H. WESTON, a captain in the Corps of Engineers, died in Washington, D. C., on Oct. 29. Capt. Weston was 33 years old at the time of his death. After graduating from the U. S. Military Academy in 1925 he continued his studies and in 1928 received a bachelor of arts degree and in 1934 a master of arts degree from Oxford University. His work at Oxford University was done under a Rhodes scholarship. Capt. Weston graduated in the civil engineering course with a bachelor of science degree from the Massachusetts Institute of Technology in 1931.

CONSTRUCTION STATISTICS FOR THE WEEK

HEAVY state and municipal awards bring the engineering construction volume total to $32,691,000 for a 4-day week. This is made up of private $3,716,000 and public $28,975,000 of which federal is $2,099,000 and state and municipal, $26,876,000. Corresponding figures last year were, total, $19,519,000; private, $2,734,000; public, $16,785,000; federal, $5,711,000 and state and municipal, $11,074,000.

Sewerage awards are high due to letting the Ward's Island intercepting sewers in New York City. The total for all sewerage contracts is $4,976,000. "Unclassified" awards are high due to the award of contract for the 6th Ave. subway in New York City. Total unclassified awards reach $8,389,000. Highway awards at $7,211,000 are higher than a week ago, bridges at $2,389,000 are double last week's volume, while building awards are lower than last week, industrial buildings, $1,278,000; commercial, $1,380,000 and public $5,113,000.

The larger awards for the week include: 6-story apartment for Brighton Beach Gardens Apartments, Inc., Brooklyn, N. Y., $550,000; academic and science buildings, Brooklyn College, Brooklyn, N. Y., $2,653,000; post office, Galveston, Tex., $552,000; highway awards by Wyoming, $481,000; by Wisconsin, $2,702,000; Manhattan approach to Triborough Bridge, $1,495,000; steel and concrete pipe for second unit, Green River Water Pipe Line (2 contracts), Tacoma, Wash., $320,000; Contracts 6, 7, 8, Section 3, intercepting sewers for Ward's Island Sewage Treatment Works, New York, $4,468,000; telephone system improvements for Carolina Telephone and Telegraph Co., Raleigh, N. C., $800,000; 1st section, 6th Ave. subway from 40th to 47th St., New York, N. Y., $6,040,000.

New capital for the week includes $13,293,000 in state and municipal bond sales of which $4,063,000 represents a transfer from federal to private financing through selling PWA bonds in the open market. WPA allotments are being put through with a decreasing amount of detail given as to how it is proposed to use the money. "Community Service Programs" are frequent recipients of allotments. Several releases this week announced allotments and the signing of warrants. These have not been included in the new capital figures reported here.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Nov. 1934	Prev. 4 Week	Week Nov.7 1935
Federal Government	$6,333	$6,632	$2,099
State and municipal	16,724	19,154	26,876
Total public	$23,057	$25,786	$28,975
Total private	3,826	12,709	3,716
Week's total	$26,883	$38,495	$32,691
Cumulative to date: 1934..$1,184,470,000		1935..$1,232,363,000	

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

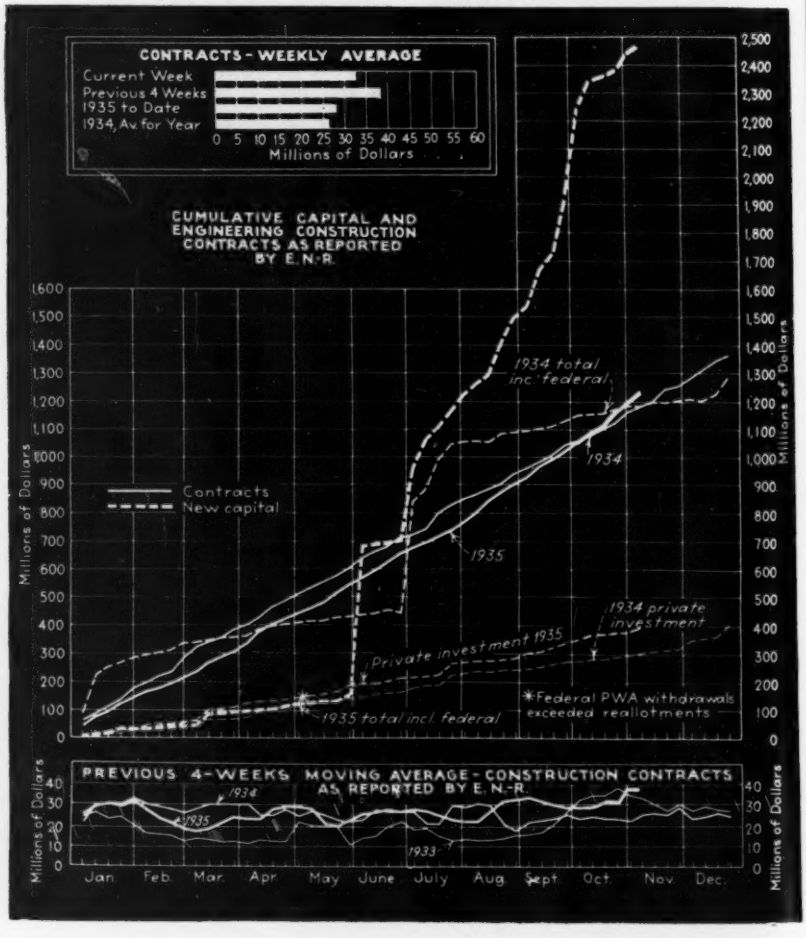
1935	Week Nov.7	Cumulative
State and municipal	$13,293*	$370,244
PWA allotments, S&M	—7,888*	742,837
RFC loans, S&M	....	48,180
Corporate issues	....	27,738
PWA private	....	9,086
Local contrib. to WPA	3,411	30,159
Total non-federal	$8,816	$1,228,244
PWA federal	29,284	1,238,035
Total new capital	$38,100	$2,466,279
Cumulative to date: 1934..$1,187,167,000		1935..$2,466,279,000

*Includes transfer from federal to private financing through sale by RFC of PWA bonds.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for federal construction, deficiency act funds. An arbitrary percentage (25%) of the WPA allotments and local contributions to WPA work is included to allow for the capital additions through the Works Progress Administration division of the new program.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Nov., 1935	196.90	93.69	Oct., 1935	162	71
Oct., 1935	195.10	93.82	Sept., 1935	127	56
Nov., 1934	201.36	96.76	Oct., 1934	101	44
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1935 to Date
1934, Av. for Year
0 5 10 15 20 25 30 35 40 45 50 55 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.R.
Millions of Dollars
Contracts
New capital
1934 total incl. federal
1934
1935
1934 private investment
Private investment 1935
1935 total incl. federal
*Federal PWA withdrawals exceeded reallotments
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY E.N.R.
1934
1935
1933
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Construction Equipment and Materials

Positive Clearing Features Continental Ripper

A ripper and scarifier with unusual construction allowing the frame to completely revolve and thereby assuring positive clearing of the ripping teeth has been developed by the Continental Roll & Steel Foundry Co., Chicago, Ill. The ripping unit is so mounted that it can not only be lifted clear of the ground but also completely revolved about, allowing debris fouled on the teeth to be taken off.

The Rollclear ripper is tractor drawn, and is especially designed for scarifying

old gravel, macadam and asphalt roads. It is equally useful for loosening hard packed soil and frozen ground. It is designed so as to allow for scarifying with any or all of the five teeth with which it is furnished. Using all of the teeth provides a ripping path 58 in. wide. Depth of cut is under the operator's control at all times and can be varied from 3 in. to 14 in. The teeth are easily removed by knocking out the wedges.

Rollclear rippers are made in two models, hydraulically operated and hand operated. A hydraulic jack, located on the ripper frame, raises and lowers the wheels at the operator's discretion, assuring complete control.

Two-Ton Roller Developed For General Utility

A two-ton tandem roller, which has been designed for general light rolling work, is now being marketed by the C, H, & E Manufacturing Co., Milwaukee, Wis. The roller is especially useful for bituminous road patching, highway shoulders, sidewalks and driveways.

The C, H, & E roller can be used in narrow and restricted places which are inaccessible to large rollers. It can be used between street car tracks and close to curbings. With the rear roller empty it weighs 3,000 lb. and with the roller filled with water it weighs 4,000 lb. Overall length of the machine is 7 ft. 8 in. and the width is 3 ft. 9 in. The front roller is 24 in. in diameter and 27 in. wide, the rear roller is 34 in. wide and 36 in. in diameter. Compression with the roller empty is 65 lb. per lin.ft., with the roller filled, 95 lb. per lin.ft.

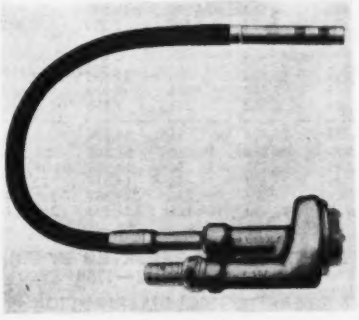
Simplicity Features New Bantam Weight Trailer

Low center of gravity and ease of loading and unloading have been stressed in the new trailer unit especially designed for transporting the P&H Bantamweight excavator introduced earlier this year by the Harnischfeger Corp., Milwaukee, Wis.

Loading is simplified by removing the front axle and placing ramp blocks to allow the machine to crawl above the frame, the front of which is then hoisted with the dipper so that the front wheels may be positioned as the machine settles onto the trailer. The process is reversed in unloading. An average of only ten minutes is required for loading; ten minutes for unloading. The unit has a wheelbase of 174 in. and a turning radius of 30 ft. to assure maneuverability.

Light Weight Sump Pump Driven by Vibrator Set

A new type sump pump has recently been perfected by the Mall Tool Co., Chicago, Ill. The pump, which has a 2-in. discharge opening and a rated capacity of 4,500 gal. per hour against a 25-ft. head, is



light enough to be carried by one man. It is made of non-corrosive metals to insure longer life. The pump has a non-clogging intake and when being used is submerged in water. It can be operated from a gasoline engine or electric set that is equipped with a vibrator shaft. The pump unit includes 3½ ft. of flexible shaft that is to be connected to the vibrating shaft.

New Equipment in Brief

First Aid for Snake Bite. A first aid kit, for men working in areas where poisonous snakes are common, is being marketed by the Davis Emergency Equipment Co., New York City. The combination outfit contains a standard first aid kit and a snake bite kit which includes a tourniquet, lancet, an unbreakable syringe, antiseptics, bandages and ammonia inhalant.

Triangular Protractor. A new device for measuring and computing angles is being marketed by the Triangular Protractor, Brooklyn, N. Y. It combines an ordinary inch scale with natural sines, cosines and tangents as well as degrees, minutes and seconds. The trigonometrical functions as measured on the scale and from the tables, printed on the scale, the value of the angle can be computed.

Light Weight Drill. A small electric drill, 6¾ in. overall, and weighing but 2½ lb., has been developed by the Independent Pneumatic Tool Co., Chicago. These new tools which are available in ¼ in. and ⅜ in. capacities have a speed of 2,500 and 3,750 r.p.m. These Thor U-14 and U-13 drills are equipped with Jacobs chucks and one extra set of brushes.

New Publications

THERMOID INDUSTRIAL BRAKE LININGS. Thermoid Rubber Co., Trenton, N. J. 8½x11, 8 pages.

GOODRICH ELECTRO-PAK BATTERIES. B. F. Goodrich Co., Akron, Ohio. 8½x11, 16 pages.

FLOOR LINE SPREAD UNIT HEATERS. Trane Co., La Crosse, Wis. 8½x11, 24 pages.

CINCINNATI ALL-STEEL SHEARS. Cincinnati Shaper Co., Cincinnati, Ohio. 8½x11, 24 pages.

UNIT VENTILATORS AND SPEED HEATERS. B. F. Sturtevant Co., Hyde Park, Mass. Catalogs 377-1 and 396-2, each 8½x11, 20 pages.

WORTHINGTON DOUBLE HELICAL ROTARY PUMPS. Worthington Pump and Machinery Corp., Harrison, N. J. 8½x11, 12 pages.

CATERILLAR POWER CONTROLLED ELEVATING GRADERS. Caterpillar Tractor Co., Peoria, Ill. 8½x11, 38 pages.

TRACKWORK FIXTURES. Ramapo Ajax Corp., New York, N. Y. 8½x11, 19 pages. Bulletin 35.

NICKEL MANGANESE STEEL WELDING ROD. American Manganese Steel Co., Chicago Heights, Ill. 8½x11, 6 pages, Bulletin No. 19.

HANDBOOK OF INDUSTRIAL TIRES. B. F. Goodrich Co., Akron, Ohio. 5½x8½, 23 pages.

FWD ROAD MAINTAINERS. Four Wheel Drive Auto Co., Clintonville, Wis. 8½x11, 12 pages.

TWO STAGE AIR-COOLED COMPRESSORS. Chicago Pneumatic Tool Co., New York, N. Y. 8½x11, 11 pages. Bulletin 759.

RIVERS OF DIRT. Jeffrey Manufacturing Co., Columbus, Ohio. 8½x11, 13 pages. Belt conveyors at Grand Coulee Dam.

PIONEER CONVEYORS. Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn. 8½x11, 15 pages.

Business Notes

H. W. PORTER & Co., Newark, N. J., manufacturers of Therm-O-Tile underground steam conduit systems, has announced the following concerns as distributors: Reid Hayden, Inc., Baltimore, Washington, Richmond and Charlotte; Brooks-Fisher Insulating Co., Atlanta; Johns-Manville Sales Corporation, Albany, Dallas, Hartford, St. Louis, Kansas City, Tulsa, Omaha; Smith-Murray Corporation, Syracuse; Asbestos & Magnesia Materials Co., Chicago; Aycock Corporation of Texas, Houston; General Asbestos & Supply Co., Indianapolis, Louisville; Milwaukee Insulation Co., Milwaukee; The Nicely Corporation, Philadelphia; Taylor-Siedenbach, Inc., New Orleans and Birmingham; Johnson Asbestos Co., Springfield, Mass.

REVERE COPPER & BRASS INC., Philadelphia, Pa., has recently acquired the Baltimore Tube Co., Baltimore, Md.

THE KENNEDY VALVE MANUFACTURING CO., has appointed William Godbey, of Kansas City, Mo., as representative.

THE INLAND STEEL CO., Chicago, Ill., has acquired the assets and business of Joseph T. Ryerson & Son, Inc. Edward L. Ryerson, Jr., Joseph T. Ryerson and Everett D. Graff, who had been directors of Joseph T. Ryerson & Son, Inc., were added to the board of directors of Inland Steel Co.

THE CHAPMAN VALVE MANUFACTURING CO., Indian Orchard, Mass., and the Pelton Water Wheel Co., San Francisco, Calif., have completed arrangements consolidating the engineering and research data of both companies and giving to each company a complete line of special and standard equipment for waterworks, pumping plants, filtration and sewage disposal plants.

REPUBLIC STEEL CORP. has appointed Frank F. Chiles as assistant manager of sales of the bar division, with headquarters at Youngstown, Ohio.

BUSINESS SIDE OF CONSTRUCTION

October Awards Highest in 4 Years Private Awards Set New Pace

ENGINEERING construction in October chalked up $182,631,000, the largest volume since October, 1931. Private awards are increasingly responsible for this improvement. The figures are: private, $60,282,000; public, $122,349,000; federal, $32,811,000, all for a 5-week month. Corresponding figures last year for a 4-week month are: total, $90,501,000; private, $14,989,000; public, $75,512,000 and federal, $12,136,000. The 10-months' totals compare with last year as follows: total $1,199,672,000 compared with $1,125,029,000; private, $318,425,000 with $198,224,000; public, $881,247,000 compared with $926,805,000; federal, $288,887,000 compared with $312,589,000.

The improved position in October is due to a substantial increase in building awards led by industrial buildings totalling $31,913,000. Public buildings totalled $28,525,000 for the month and commercial buildings $14,958,000. Highway awards increased as the federal money was freed and reached the record volume for the year of $48,304,000. Earthwork and waterways awards contributed $20,648,000 to the total.

Geographically all territories show increases over last year while New England, Middle Atlantic, Middle West and Far West also show increases over last month.

New capital

New capital for non-federal work includes for October, $250,000,000 in PWA allotments, $12,000,000 RFC loans, $45,000,000 in state and municipal bond sales and $4,500,000 in corporate security issues for private construction. Total financing for non-federal work recorded during the first 10 months is $1,219,428,000 not including the $525,000,000 highway allotments. The cumulative total including federal is $2,428,179,000 compared with $1,175,51[illegible],000 last year. The private investment market for both state and municipal and corporate securities continues active. The large majority of corporate securities offered, however, are for refunding purposes. This condition has been true since spring. A normal transition from the present large-scale refunding program to a market for new capital is the next logical development in the investment market predicted by Ralph T. Crane, president of the Investment Bankers Association at the annual meeting held at White Sulphur Springs this month.

Materials

Cement—Cement shipments in September totalled 7,799,000 as reported by the Bureau of Mines. This is an increase of 5.6 per

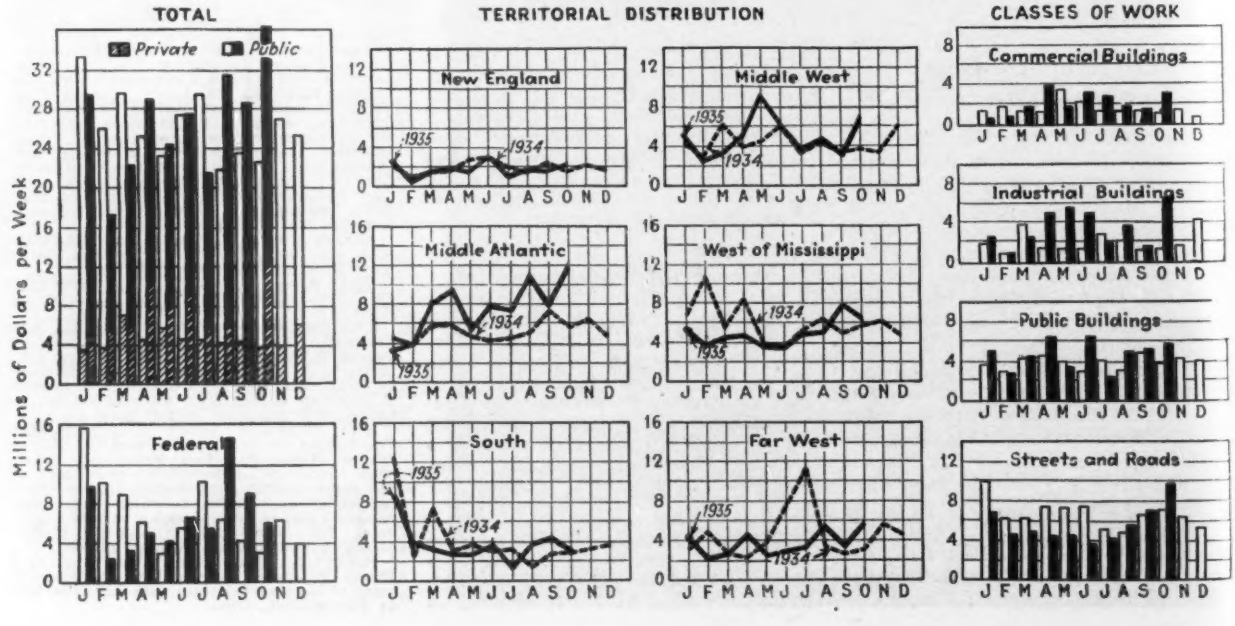
ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN OCTOBER, 1935

Five Weeks—Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States October 1935	United States Ten Months 1935	United States Ten Months 1934	Canada
Public Works										
Waterworks	422	1,026	406	1,055	504	2,403	**5,816**	59,062	57,353	299
Sewerage	1,116	2,258	319	851	717	134	**5,395**	57,440	48,987	440
Bridges, public	648	4,032	335	1,453	2,434	1,094	**9,996**	59,466	77,963	665
Earthwork and waterways	1,205	487	2,101	616	3,434	12,805	**20,648**	200,715	230,036	2,504
Streets and roads	3,818	10,448	6,432	6,514	16,785	4,307	**48,304**	250,173	291,991	2,386
Buildings, public	1,392	10,769	4,095	6,913	2,356	3,000	**28,525**	206,677	166,152	1,987
Unclassified, public	281	1,593	399	656	140	596	**3,665**	47,714	54,323	1,652
Total public	8,882	30,613	14,087	18,058	26,370	24,339	**122,349**	881,247	926,805	9,933
Federal gov't (included in above classifications)	2,083	3,778	4,897	7,737	5,097	9,219	**32,811**	288,887	312,589	.....
Private										
Bridges, private	.....	703	.....	231	.....	.....	**934**	10,436	9,693	.....
Buildings, industrial	1,421	12,884	586	11,565	2,517	2,940	**31,913**	155,014	79,707	1,488
Buildings, commercial	785	7,647	750	2,979	2,162	635	**14,958**	92,450	70,437	1,247
Unclassified, private	89	8,582	205	1,391	1,535	705	**12,507**	60,525	38,387	10
Total private	2,295	29,816	1,541	16,136	6,214	4,280	**60,282**	318,425	198,224	2,745
October, 1935 (5 weeks)	**11,177**	**60,429**	**15,628**	**34,194**	**32,584**	**28,619**	**182,631**	.....	.....	**12,678**
September, 1935 (4 weeks)	6,043	32,158	17,254	13,756	31,160	14,469	**114,840**	.....	.....	8,262
October, 1934 (4 weeks)	6,144	23,007	11,418	14,814	22,669	12,449	**90,501**	.....	.....	4,089
Ten months, 1935	76,711	339,604	166,756	222,864	221,924	171,813	.....	1,199,672	.....	78,382
Ten months, 1934	83,164	222,520	184,113	185,255	260,571	188,406	.....	.....	1,125,029	38,637

ENGINEERING CONSTRUCTION REPORTED BY E.N.-R.—WEEKLY AVERAGES

□ ---1934 ■ —1935



cent over September a year ago. Stocks at mills were 0.3 per cent higher than a year ago. For the 9 months shipments amount to 55,651,000 bbl. compared with 58,700,000 bbl. in 1934 and reflect the lag in heavy construction during the first nine months of the year. The ratio of production to capacity in September was 32.6 per cent compared with 34.8 per cent a year ago and 31.8 per cent last month.

Steel—The average operating rate of steel companies having 98.2 per cent of the steel capacity of the industry reporting to the American Iron and Steel Institute was 50.9 per cent during October compared with the preceding week average of 50.7, the preceding month average of 49.4 and the corresponding 4-weeks' average in 1934 of 23.8 per cent. The trend was up from 49.7 per cent in the first week of October to 51.9 per cent for the last week.

Production of fabricated structural steel for September, estimated for the entire industry by the American Institute of Steel Construction, is 85,711 tons compared with 97,490, the revised tonnage for August and 92,922 the revised figure for July. These represent 36.6 per cent, 41.7 and 39.7 per cent of the shipped tonnages published by U. S. Dept. of Commerce for 1928-1931. Shipments for the first 9 months were 38.9 per cent of the 1928-1931 average while September shipments were 40.1 per cent (subject to revision), August 52.2 per cent and July 42.4 per cent. Tonnage available for fabrication within next four months is estimated at 229,372 for the industry and for fabrication thereafter 64,331 tons.

Lumber—Lumber shipments were lower in October, averaging about 221,075,000 feet as reported by the National Lumber Manufacturers Assn. Production is running 30 to 35 per cent above a year ago. For the nine months it is about the same as a year ago but the higher rate than last year in the fourth quarter is expected to raise the year's total production to 4 or 5 per cent above 1934.

Index of Shipments—The Federal Employment Stabilization Board (now to be known as Space Control, Advance Construction Programs Unit) has compiled an index of shipments of construction materials based on thirty individual series representing shipments of construction materials. These include Terra Cotta, Floor & Wall Tile, Steel Plate, Enameled Sanitary Ware, Vitrified China Plumbing, Water Softening Apparatus, Pumps & Water Systems, Steel Boilers, Plumbing Porcelain, Prepared Roofing, Oil Burners, Paint Varnish, Range Boilers, Plumbers' Woodwork, Plastic Paints, Asphalt, Cement, Explosives, Face Brick, Cast Iron Boilers, Radiators, Maple Flooring, Oak Flooring, Limestone, Concrete Reinforcing Steel, Gas-fired Boilers, Rubber Flooring, Window Glass, Lead Pipe and Oakum. This index averaged 42 for 1933 based on 1929 = 100 and 48 for 1934. In January, 1935, this index of shipments of construction materials was 34. Revised figures reported for July and August are 61 and 68 respectively and the preliminary figure for September is 71.

Building permits

Permit values for the 215 cities reporting regularly to Dun and Bradstreet, Inc., totalled $47,288,974 for the month of September, compared with $55,536,546 during August. This represented a loss of 14.8 per cent, against a usual seasonal drop of about 10 per cent. Last month's figure compared with $26,567,925 in September, 1934, or an increase of 78.0 per cent.

Geographically the comparison with building permits issued last year is: New England, —5.5 per cent, Middle Atlantic, +61.0 per cent, South Atlantic, +128.0, East Central, +82.9, South Central, +109.7, West Central, +51.8, Mountain, +468.3, and Pacific, +90.4 per cent. New York City permits show a gain over September, 1934 of 58.8 per cent while outside of New York City the gain is 83.4 per cent.

According to the Bureau of Labor statistics reports from 770 cities indicate an increase in September over a year ago of 28.7 per cent in number of building permits and 88.1 per cent in estimated cost of structures represented. This is distributed: to new residential, 176.7 per cent gain in number and 167.4 per cent gain in estimated cost; new non-residential, 27.8 per cent gain in number and 85.4 per cent in estimated cost. Additions, alterations and repairs permits show a gain of 18.2 per cent in number and 39.4 per cent in estimated cost.

Labor

New York State during September reports 14 industrial fatalities chargeable to construction out of a total of 44 in the state.

Employment in the construction industry in New York State advanced 3.4 per cent from July to August. These statements are based on the reports of 1,283 firms working in either July or August or both months. They employed 34,190 workers with a payroll of $869,286 for 1,032,065 hours worked.

The greatest improvement was in the miscellaneous general contracting group where employment increased 7.7 per cent; subcontractors increased employment by 3.5 per cent, highway contractors by 2.0 per cent and general building contractors by 1.1 per cent.

The carpenter strike in Washington which went into effect in the Library of Congress annex on August 30 ended when work was resumed on October 16. Terms of the settlement were not released. Specifications for the work stipulated $1.25 an hour as the rate for carpenters which was correct at the time but the "prevailing" wage scale was subsequently raised to $1.37½ an hour and the carpenters on strike were demanding the higher rate.

Other labor controversies reported during the month affected the Works Progress Administration wage policies. Protests have resulted in decisions to pay "prevailing wages" for skilled labor at Newark, in the states of Mississippi and Ohio, and in San Francisco.

A 10 per cent wage increase for WPA laborers on up-state New York projects was ordered at Albany on October 22, together with a promise to negotiate with Washington for sufficient funds to pay "prevailing wages" following protests from organized labor against the "security" rates.

WPA in Massachusetts established the prevailing rate of wages for both skilled and unskilled labor to be paid after Nov. 1.

At Buffalo, N. Y., a strike of relief workers varying in number up to 1,000 men was ended officially Oct. 28, with an adjusted wage scale which increased the rate first proposed about 20 per cent and cut hours from 140 to 128 per month for unskilled labor.

Three labor strikes on work-relief projects were reported in Western Maryland on October 28 with workers in Baltimore also failing to appear for work. WPA employees outside of Baltimore are demanding 50c. per hour. The WPA rate is 28.6c.

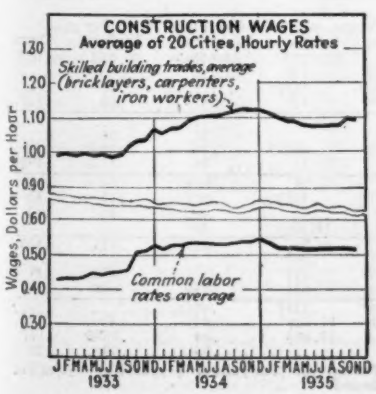
ENR Cost and Volume Index

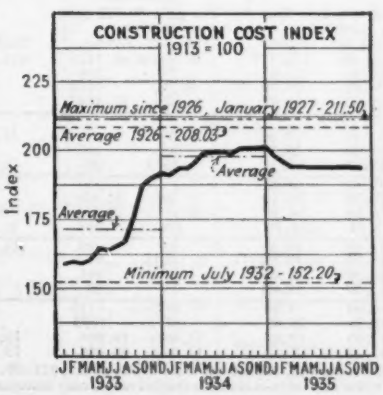
The *Engineering News-Record* Construction Cost Index is 194.90 for November, due to a slight adjustment in labor rates. Minor variations in material costs are purely local in character.

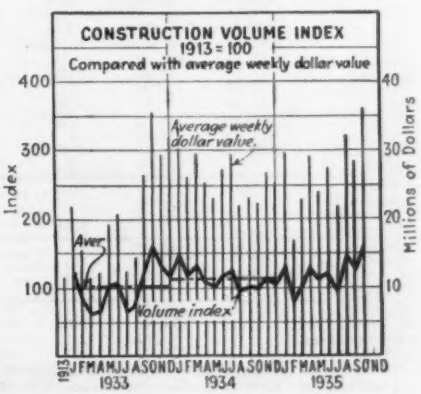
The ENR Volume Index is 162 for October, the highest value since October, 1931, except October, 1933, when the low cost index produced a volume index of 162 from a lower dollar volume than that recorded this year.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Nov., 1935	**194.90**	**93.69**	**Oct., 1935**	**162**	**71**
Oct., 1935	195.10	93.82	Sept., 1935	127	55
Nov., 1934	201.36	96.76	Oct., 1934	101	44
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.83	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONSTRUCTION WAGES
Average of 20 Cities, Hourly Rates
Skilled building trades, average (bricklayers, carpenters, iron workers)
Common labor rates average
Wages, Dollars per Hour
1.30
1.20
1.10
1.00
0.90
0.60
0.50
0.40
0.30
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935


CONSTRUCTION COST INDEX
1913 = 100
Maximum since 1926, January 1927 - 211.50
Average 1926 - 208.03
Average
Average
Minimum July 1932 - 152.20
Index
225
200
175
150
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935



CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c. per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE Ready Mixed 1:2:4, 50c.y. or more, delivered
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.89	$2.64	$2.44	$2.31	$2.31	$1.64	$1.69	$1.92	$1.80	$1.80	$8.25
Baltimore	2.69	2.44	2.24	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	2.25	2.25	7.35
Birmingham	2.55	2.30	2.10	1.75	1.75	1.40	.85	.85	.90	1.15	5.45
Boston	2.72	2.47	2.27	1.50	1.50	1.10	1.50	1.50	.....	.....	7.00
Chicago	2.85‡	2.60‡	2.40	2.60‡	2.60‡	2.05‡	2.60‡	2.60‡	.....	.....	.....
Cincinnati	2.50	2.25	2.05	1.20	1.20	1.10	1.80	1.80	.....	.....	6.70
Cleveland	2.26	2.01	.....	1.40	1.40	1.30	1.60	1.60	1.75	1.75	7.50
Dallas	2.45	2.20	2.00	1.55	1.55	1.30	2.10	2.25	.....	.....	7.00
Denver	3.09	2.84	.....	1.85	.....	1.25	.....	.....	.....	.....	.....
Detroit	2.26	2.01	1.81	1.30	1.30	1.20	1.40	1.60	1.40‡	1.50‡	6.75
Kansas City	2.50	2.25	2.05	.....	1.85	1.15	1.85	1.40-1.55	.....	.....	7.65
Los Angeles	2.70	2.42	.....	1.40	1.40	1.00	1.40	1.40	.....	.....	6.70†
Minneapolis	2.90	.....	2.45	1.00ᵖ	1.00ᵖ	.25ᵖ	1.00ᵖ	1.00ᵖ	.....	.....	5.75
Montreal	.....	1.70	.....	.85	.90	1.25	1.25ᵖ	1.60ᵖ	.....	.....	6.00
New Orleans	2.47	2.22	2.00	1.75	1.75	1.45	.....	.....	.....	.....	8.25
New York	2.30‡ᵤ	2.05‡ᵤ	.....	1.40†ᵏ	1.40†ᵏ	.75†ᵏ	1.75†ᵏ	1.85†ᵏ	.....	.....	7.60
Philadelphia	2.63	2.38	2.18	1.80‡	1.90‡	1.50‡	2.60‡	2.75‡	1.00‡	1.00‡	7.75
Pittsburgh	2.46	2.21	1.61	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.00
St. Louis	2.53	2.28	.....	1.40‡	1.40‡	1.40‡	.75ᵖ	.75ᵖ	.75§	.75§	6.65
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	.....	.....	7.53
Seattle	3.09	2.84	.....	1.00	1.00	1.00	1.44	1.44	.....	.....	7.56

*10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill. ᵏBarge lots alongside dock. ᵖf.o.b. plant. ᵗ5 tons or more. ᵤWithin 6-mi. zone. ᵤFor delivery via Erie Basin only. Subject to change without notice.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich	$1.50	$1.45	Ironton, Ohio	$1.60	$1.55	North Birmingham, Ala	$1.75	$1.70
Buffington, Ind	1.70	1.65	Iola, Kans	1.70	1.65	Richard City, Tenn	1.85	1.80
Crestmore, Calif	1.72	.....	La Salle, Ill	1.70	1.65	Saginaw, Mich	1.50	1.45
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.70	1.65	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.70	1.65	Mason City, Ia	1.70	1.65	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Norfolk, Va	1.76	1.71	Waco, Tex. (Inc. 5c. Tax)	1.80	1.75
Independence, Kans	1.70	1.65	Northampton, Pa	1.65	1.60	Wyandotte, Mich	1.45	1.40

Cash Discounts, Cement, to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount, 10c. per bbl. for payment within 15 days of date of invoice.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED (Per M, lots of 2,000 pieces or over)			STRUCTURAL CLAY TILE—LOAD BEARING—SCORED (Per M, lots of 2,000 pieces or over)			BRICK (Per M, in quantity)		LIME (Per ton, in paper, carload lot)		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	Pulverized or lump
Atlanta	$75.80	$80.80	$151.60	$181.90	$212.20	$242.50	$14.25	$14.25	$24.00	$17.00	$15.90
Baltimore	91.00	98.00	183.00	219.00	315.00	390.00	13.00	17.00	17.00	12.50	19.25
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	22.50	3.00§	1.75§	2.25§ᵒ
Boston	72.50ᵣ	77.45ᵣ	145.35ᵣ	164.50ᵣ	203.70ᵣ	.....	14.50	18.00	17.50	12.50	3.10ᵩᵒ
Chicago	66.00	70.40	132.00	.....	.....	.....	10.20	11.20	18.00	13.40	14.00
Cincinnati	55.00	58.70	110.00	124.10	164.20	187.70	17.50	17.50	15.97	12.48	.....
Cleveland	45.00	48.00	90.00	108.00	138.50	158.50	13.00	13.00	14.00k	12.00k	2.65kp
Dallas	72.00	75.00	197.00	177.00	217.00	269.00	13.50	26.00	21.20	14.50	1.70 p
Denver	78.50	88.00	141.50	166.50	196.00	225.00	10.00-15.50	21.00-30.00	25.00	17.00	20.00
Detroit	71.85	76.65	143.70	230.00	280.00	325.00	11.50	12.50	14.25	11.90	22.20
Kansas City	72.50	72.50	92.00*	140.50	177.75	207.25	15.00	24.00	18.90	11.89	14.20ᵒ
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	14.00	18.70	.....	19.70
Minneapolis	80.15ᵣ	85.50ᵣ	145.40ᵣ	167.75ᵣ	175.25ᵣ	243.70ᵣ	13.10	15.10x	25.50	21.00	23.00
Montreal	79.10ᵣ	90.40	169.50ᵣ	.....	212.40	136.60	20.75	31.00	15.00	10.00	7.00
New Orleans	61.60	65.10	123.20	158.90	196.70	.....	14.00	.....	16.75	13.05	.....
New York	84.00	90.00	135.00*	193.30†	238.80†	295.60†	10.00	.....	20.00	15.50	20.00
Philadelphia	76.00	80.00	150.00	172.00	240.00	295.00	18.00	20.00	16.35	11.25	10.75
Pittsburgh	58.40c	62.30c	116.85c	165.00c	217.00c	250.00c	15.00	22.00	17 20	14.50	2.22ᵩ
St. Louis	58.00	60.00	120.00	180.00	185.00	210.00	15.00	18.00	.55‡	.40‡	2.30ᵩ
San Francisco	84.00	94.50	225.00	.....	.....	.....	15.00	18.00	22.50	21.50	2.05ᵩ
Seattle	86.00	94.50	210.00	198.00	198.00	198.00	15.00ᵈ	18.50	30.00	26.00	3.00ᵩ

*6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl., 200 lbs. ᵩPer bbl. 180 lbs. ᵩper bbl. 280-lb. kLCL. ᵈless $1 cash 15 days. ᵒlump. ᵣSmooth. x Selected common.

ROAD SURFACING MATERIALS—F.O.B. CITY

	PAVING BRICK AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION	
	Granite per M, lots of 50,000, 4x4x8 in.,	Brick per M, 3x4x8½ in., carload lots	Wood per sq.yd., 3½ in., 16-lb. treat,	Per ton, less than 80 penetration,		Per gal., 80-300 penetration,		Per ton,		Per gal.,	Per gal.,	
				Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drum
Atlanta	$ 75.00	$35.00	$2.25	$17.40ᵗ	$22.57ᵗ	$0.0644ᵗ	$0.911ᵗ	$15.90ᵗ	$23.82ᵗ	$0.0586ᵗ	$0.085	$0.085
Baltimore	110.00	44.00	2.35	17.00	22.00	.07	.095	.085†	.12†	.....	.....	.....
Birmingham	110.00	24.00	.....	18.00	23.00	0.778	.1028	.082†	.112†	.....	.06	.....
Boston	75.00	28.00	2.40	16.00	21.00	16.50#	21.50#	.09†	.12†	.075	.09	.125
Chicago	125.00	42.00	2.60	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati	115.00	37.00	.....	18.00	22.00	.09	.....	18.50	.....	.07	.08	.....
Cleveland	100.00‡	32.75	2.85	19.00	23.25	.075	.085	.075†	.0425†	.06	.085	.10
Dallas	.....	30.00	.....	17.30	22.30	.0575	.105	16.85	24.35	.06	.1126	.1488
Detroit	.....	37.00	.....	19.67ᵏ	24.87ᵏ	.....	.....	17.00	22.50	.055	.11	.15
Kansas City	.....	45.00	.....	18.50	23.50	17.50#	22.50#	.077†	.107†	.057	.11	.15
Los Angeles	.....	50.00	.....	10.34	14.50	10.34#	14.50#	10.34	.....	.042	.06	.12
Minneapolis	.....	.....	2.50	18.20	24.70	.098	.098	21.85	34.65	.048	.....	.....
Montreal	70.00	60.00	.....	14.00	19.66	.07	.093	19.00	26.50	.07	.135	.165
New Orleans	100.00	32.00	.....	14.50	18.50	.0655	.09	.07†	.10†	.....	.....	.....
New York	130.00§	65.00	2.64	17.00	22.00	.07	.095	.085†	.12†	.....	.075	.11
Philadelphia	122.00	45.00	2.25	13.50	18.00	.05	.08	.05†	.08†	.045	.08	.....
Pittsburgh	115.00	40.00	.....	19.00	24.00	.0775	.1125	.086†	.121†	.0675	.....	.....
St. Louis	115.00	35.00	2.00	18.50	23.50	.0775	.1075	.875†	11.75†	.04	.09	.125
San Francisco	.....	50.00	.....	12.00	18.00	12.00#	18.00#	12.50#	23.00#	.04	.0575	.117
Seattle	.....	55.00	.....	25.50	25.50	17.00#	23.00#	15.00	.....	.03	.19	.20

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton, Bermudez, $25.00; Trinidad, $21.00. *Per sq. yd. †Per gallon. ‡4½x6x5½ in. #Per ton §4x5x9-in. Av. ᵏMexican. ᵗLocal reduction due to 20% reduction intra-state class freight rates, only Georgia affected.

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet,	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton			TRACK SUPPLIES			
						Standard	Light	Re-rolled	Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$1.95	$2.10	....	....	....	$36.375	$34.375	$35.00	$2.55	$2.40	$1.90	$3.55
Chicago	1.85	2.10	$3.00	....	$2.25	36.375	35.00	34.00	2.55	2.40	1.90	3.55
Pittsburgh	1.80	2.05	2.90	$2.40	2.15	36.375	35.00	34.00	2.55	2.40	1.90	3.55

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

F.O.B. WAREHOUSE	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¼ in., base price		EXPANDED METAL LATH Per 100 sq.yd., carload lots		WELDED FABRIC REINFORCING Per 100 s.f., carload lots			SHEET PILING
		New billet	Rail steel	Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq.yd.	Per 100 lb. base price
Atlanta	$3.36	$2.34	$2.19	$21.00	$23.00	$1.53	$1.16	$0.1449	$2.70
Baltimore	3.00	2.75	2.60	25.00	28.00	1.41	1.08	.1332	2.90
Boston	3.54	3.08	2.25	21.00†	23.00†	1.46	1.12	.1449	2.30
Chicago	3.20	1.85	1.95	22.50	26.00	1.40	1.08	.1323	2.25
Cincinnati	3.40	3.25	3.25	25.01	29.50	1.39	1.07	.1287	....
Cleveland	3.16	2.60	2.45	20.00	22.00	1.37	1.06	.1287	....
Dallas	2.225	2.45	2.30	22.00	25.00	1.63	1.23	.1548	2.985
Denver	3.95	3.76	3.61	22.00	25.00	1.68	1.26	.1548	....
Detroit	3.42	2.20	2.05	20.00†	22.00†	1.41	1.08	.1323	2.43
Kansas City	3.75	2.75	2.60	19.00	21.00	1.50	1.14	.1422	2.69
Los Angeles	3.10	2.45	....	23.00	27.50	1.68	1.26	.1548	2.65
Minneapolis	3.45	2.86	2.71	22.00	26.00	1.51	1.15	.1431	2.57§
Montreal	2.90	2.40	2.30	25.50	28.75	2.30	1.71	.238	2.80
New Orleans	....	....	....	19.15	23.00	1.54	1.17	.1458	....
New York	3.37	2.50	2.35	18.50	20.50	1.44	1.11	.1359	2.50
Philadelphia	2.98	3.06	2.22	20.00	24.00	1.42	1.09	.1332	2.46
Pittsburgh	1.80‡	1.80‡	1.70‡	20.00‡	22.00‡	1.34	1.04	.1260	2.15
St. Louis	3.45	2.45	2.30	22.00	24.00	1.42	1.09	.1341	2.25
San Francisco	3.50	2.475	2.325	23.00	28.00	1.68	1.26	.1584	2.60
Seattle	3.55	2.50	....	30.00	33.00	1.68	1.26	.1584	2.60

‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts. §Mill Price plus freight to Minneapolis. †f.o.b. delivered.

PAINTING AND ROOFING SUPPLIES—F.O.B.

	RED LEAD Per 100 lb. in 500-lb. lots	WHITE LEAD Per 100 lb. in 500-lb. lots#	READY-MIXED PAINT Per gal., drums			ROOFING SUPPLIES Carload lots, f.o.b. factory				
	Dry	in oil	Graphite*	Aluminum†	Ferric Oxide‡	Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350-lb. bbl., per ton
Atlanta	$7.75	$10.50	$1.60	$3.10	....	$1.79	$1.97	$2.90	$.36	$25.40
Baltimore	7.00	10.00	1.40	2.25	$1.90	2.35	2.55	2.55	.48	25.00
Birmingham	7.25	10.50	2.35	2.35	1.85	1.70	1.79	....	.36	21.88
Boston	7.00	10.00	1.75	2.60	.04½x	1.80	2.80	2.80	.38	20.00
Chicago	7.00	10.00	1.85	2.45	1.30	1.60	1.59k	1.59k	.24	20.00
Cincinnati	7.00	10.00	1.45	2.50	1.40	2.40	2.39k	2.39k	.36	21.00
Cleveland	7.00	10.00	1.65	2.30	1.30	1.60	1.79	1.79k	.24	20.00
Dallas	7.25	11.00	1.80	2.24	....	2.60k	4.47	4.47	.16	37.50
Denver	7.50	10.75	2.55	....	....	2.75	3.46	3.46	.60	30.00
Detroit	7.00	10.00	1.55	2.20	1.30	2.55	2.80	2.55	.35	30.00
Kansas City	7.00	10.12½	1.25	2.25	1.00	1.76	3.10–3.20	3.10–3.20	.23	26.50
Los Angeles	7.25	10.25	1.60	2.25	2.30	2.00	1.50	....	.45	....
Minneapolis	7.00	10.12½	....	....	....	1.60	1.79k	1.79k	.29	25.30
Montreal	....	8.20	1.85	3.50	1.85	1.90	2.44	1.88	1.40§	1.52§
New York	7.00	10.00	1.60	2.25	1.40	1.60	1.79k	1.79k	.232	22.00
Philadelphia	7.00	10.00	2.50	2.95	1.50	1.68	1.86k	1.48k	.37	22.00
Pittsburgh	7.00	10.00	1.05	1.95	.80	1.75	1.65k	1.65	.38	25.00
St. Louis	10.00	10.00	1.85	2.45	1.30	1.76k	3.00	3.00	.26	25.00
San Francisco	7.25	10.25	1.80	2.75	1.10–2.00	1.89	3.10	3.10	.38	26.00
Seattle	7.25	10.25	1.80	2.85	2.20	3.30	2.66	2.60	.60	30.00

*U. S. War Dept. Spec. 3-49A. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. §Per 100 lb. kPer roll, 65 lb. xPer lb.
Note: Red lead in oil 59c higher than white lead in oil. #Basis of quoting changed this month from list to 500-lb. lots.

MISCELLANEOUS ITEMS

	WINDOW GLASS Discounts from latest jobbers List, Sept. 15, 1928 Single or Double Thickness		EXPLOSIVES Per lb. dynamite delivered 50-lb. cases Gelatin	
	A quality	B quality	40%	60%
Atlanta	85%	85%	$0.155	$0.17
Baltimore	88–10%	90–10%	.16	.175
Birmingham	88%	90%	.105	.120
Boston	88–10–5%	90–10–5%	.18	.19
Chicago	90%	92%	....	....
Cincinnati	89–10%	91–10%	.27	.29
Cleveland	85–10%	85–10%	.19	.205
Dallas	86%	88%	.17	.185
Denver	86%	88%	.155	.17
Detroit	87–10%	89–10%	.225	.240
Kansas City	88–10%	90–10%	.16	.175
Los Angeles	90%*	90–40%	.1725†	.1925†
Minneapolis	86%	88%	.175	.19
Montreal	....	....	.1875	.2125
New Orleans	88%	90%	.19	.22
New York	88%	90%	.225	.24
Philadelphia	88%	90%	.1550	.17
Pittsburgh	88%	88%	.11	.1250
St. Louis	89%	89%	.135	.15
San Francisco	82%	87%	.1575	.1775
Seattle	90–10%	90–20%	.1425	.1575

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal. ‡Double thickness A & B.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York.	
Bleaching powder, in drums, F.o.b. works, per 100 lb.	$1.90@$2.15
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00@35.00
Chlorine cylinders, per lb. delivered	.055
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in paper bags, per 100 lb.	1.20
Sulphate of aluminum, commercial, in 100 lb. bags per ton	27.00
Sulphate of copper, in bbl., per 100 lb.	3.85

PILES

Prices per linear foot, pine, with bark on f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf—Barge	Short Leaf—Rail	Long Leaf—Barge	Long Leaf—Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.12	$0.165	$0.13	$0.16
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.16	.21	.15	.20
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.17	.225	.16	.21½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.195	.235	.20½	.24½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2125	.245	.24½	.30½
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.275	.385	....	....
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.315	.452	....	....

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$1.25	$1.80
	Pine, untreated	1.35	1.85
	Pine, creosoted	1.75	2.45
New York	Long-leaf sap pine, untreated	.80	1.00
	Mixed oak, untreated	....	1.00
	White oak, untreated	.75	1.50
Birmingham	White oak, creosoted	no market	
	Southern pine, untreated *6x8x8'6'	.45*	.60
	Southern pine, creosoted	1.00*	1.20
Chicago	White oak, untreated	1.15	1.40
	Oak, empty cell, creosoted	1.50	1.88
	Oak, zinc treated	1.40	1.70
	Southern pine, creosoted	1.35	1.78
Los Angeles	Fir, untreated	.50	.72
	Fir, creosoted	1.67	2.40
Philadelphia	Red oak, untreated	1.00	....
	Red oak, creosoted	....	2.10
	White oak, untreated	1.03	1.35
St. Louis	Red oak, untreated	1.00	1.30
	Red oak, creosoted	1.45	1.90
	Sap Pine or cypress, untreated	.90	1.25
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.10
	Birch or maple, creosoted	1.25	1.55

CURRENT PRICES OF CONSTRUCTION MATERIALS

WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE			
	Per net ton, f.o.b. 6 in. to 24 in.*	Per foot, delivered, standard (‡ f.o.b.) 8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	Per ft., delivered; ASTM C 14-24 12 in.	24 in.	Full standard weight. # 1 to 3 in., Black	Butt Weld Galv.	3½ to 6 in., Black	Lap Weld Galv.
Atlanta	$43.00	$0.225	$0.405	$1.4625	$3.25	$80.00	$128.00	$0.50	$1.625	44%	37%	42%	34%
Baltimore	46.50	.25	.50	2.10	5.75	108.00	168.50	.75	2.00				
Birmingham	39.00	.25	.45	1.625	4.66	85.00	200.00	.45	1.60	48.939%	37.918%	50.162%	39.143%
Boston	46.50	.196	.378	1.72	5.06	50.00	82.50	.378	2.15				
Chicago	47.50	.285	.54	1.98	5.60	85.00	120.00	.675	2.25	56%	45%	55%	40%
Cincinnati	46.00	.203	.3915	1.665	5.125	69.00	108.00	.40	1.40	53.04%	42.02%	54.265%	43.245%
Cleveland	47.50	.14	.27	1.17	3.9975	47.25	72.00	.536	2.102	58.4%	48.4%	60.6%	49.6%
Dallas	51.00	.25	.45	1.80	.....	160.00	250.00	.41	1.41	64%	53%	64%	56%
Denver	59.00	.23‡	.415‡	1.73‡	.....	.....	.....	.....	.....	56%	45%	43%^	57%^
Detroit	47.50	.245	.4725	2.025	5.74	82.00	136.00	.35	1.20	48.6%	38.2%	47.3%	37.6%
Kansas City	49.00	.32	.57	2.27	4.90	120.00	240.00	.40	1.50	49%	38%	50%	39%
Los Angeles	47.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	53.57%	43%	53%	42.51%
Minneapolis	49.50	.255	.459	1.836	4.67	.....	.....	.50	1.34	.....	.....	.....	.....
Montreal	55.00	.80	1.50	6.00	.....	45.00	75.00	.45	.....	.....	.....	.....	.....
New Orleans	45.00	.32	.51	1.65	.....	67.00	.....	.45	2.00	.....	.....	.....	.....
New York	46.00	.26	.51	2.25	6.75	.....	.....	.55	2.00	51.88%*	40.86%*	53.10%*	42.08%*
Philadelphia	43.00	.336	.648	2.835	8.68	175.00	210.00	.54	1.80	52.37%*	41.35%*	53.39%*	42.57%*
Pittsburgh	49.00	.175‡	.3375‡	1.44‡	4.81‡	69.00	108.00	.75c	1.75	64%	55%	65%	56%
St. Louis	46.00	.255	.459	1.836	3.96	85.00	170.00	.80	2.00	51.266%	40.245%	52.49%	41.47%
San Francisco	47.00	.265	.477	1.908	5.22	103.50	172.50	.45	2.20	52.4%	63.4%	51.1%	64.6%
Seattle	48.50	.35†	.63†	2.52†	6.30†	96.00	200.00†	.50†	1.80	60%	50%	65%	50%

*b. & s. class B and heavier, C/L lots, 200 tons and over. Burlington, N. J. (base) $43.00. Gas pipe and class A, $3 per ton additional. 4-in., $3 per ton additional. 30 in. and larger usually $2 per ton less. ‡Price at factory. †Less 30% in C/L Lots.

#Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8½c; ⅜ in. 11½c.; 1 in. 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92.

^2½ to 3 in. *Resale price to consumer, car load lots shipped from mill.

c Concrete Culvert pipe reinforced.

LUMBER AND TIMBER—PER M FT. B.M., CARLOAD LOTS F.O.B.

		SHORT LEAF YELLOW PINE AND DOUGLAS FIR—All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft.									LONG LEAF Y. P. Merchantable grade up to 20 ft.	
		1x6,#	1x8,#	2x4,#	2x6,#	2x8,#	2x10,#	3x12,#	6x12,#	12x12,#	2x12,#	12x12,#
Atlanta	Southern Pine	$16.00	$16.00	$18.00	$18.50	$20.00	$19.50	$28.00	.....	.....	$38.50	$40.00
Baltimore	Southern Pine	20.50	24.00	29.50	28.50	29.00	30.50	37.50	.....	.....	54.00	55.00
	Douglas Fir	29.50	29.00	31.00	29.00	30.00	30.50	32.00	$33.00	$34.00		
Birmingham	Long Leaf	18.00	18.25	18.25	16.25	17.25	17.25	39.00	.....	.....	34.00	36.80
	Southern Pine	18.00	18.25	17.00	15.00	16.00	16.00	26.00	26.00	25.00	.....	.....
Boston	Southern Pine	28.00	28.00	33.00†	35.00†	52.00‡	62.00‡	75.00‡	.....	.....	75.00	75.00
	Douglas Fir	28.00	28.00	33.00	33.00	33.00	36.00	40.00	43.00	43.00	.....	.....
Chicago	Southern Pine	27.00	28.00	33.50	30.00	31.00	32.50	45.00	.....	.....	53.00	57.00
	Douglas Fir	28.50	29.50	31.75	30.50	30.50	28.50	40.75	41.75	41.75	.....	.....
Cincinnati	Southern Pine	24.00	25.00	26.00	25.00	25.50	26.50	40.00	.....	.....	31.50	.....
	Douglas Fir	.....	.....	.....	.....	.....	.....	43.50	46.25	46.25	.....	.....
Cleveland	Southern Pine	28.00	30.00	36.00	30.00	34.00	36.00	47.00	45.00	.....	50.00	62.00§
Dallas	Southern Pine	d31.50	32.40	35.55	32.50	35.50	35.50	55.00	.....	.....	51.90	64.35
Denver	Douglas Fir	41.00	41.00*=	42.00*	42.00*	42.00*	46.00*	52.00*	56.00*	61.50	.....	.....
Detroit	Southern Pine	24.00	24.00	25.00	24.50	24.50	25.50	35.00	.....	.....	29.00	41.50
	Douglas Fir	.....	.....	.....	.....	.....	.....	41.50	41.50	41.50	.....	.....
Kansas City	Southern Pine	23.50	24.00	23.50	23.00	23.50	24.50	34.00	.....	.....	53.00	60.00
	Douglas Fir	27.00	28.00	28.00	27.00	27.00	30.00	33.00	35.00	35.00	.....	.....
Los Angeles	Douglas Fir	30.00,	30.00,	30.00,	30.00,	30.00,	30.00,	35.00,	39.00,	34.00,	58.00*^	.....
Minneapolis.c	Western Pine	45.00#	51.50#	50.00*	41.00#	41.00#	42.00#	59.50*^	59.50*	59.50*	.....	.....
	Douglas Fir	39.00*	42.00*	43.50*	41.00*	41.00*	42.00*	59.50*	.....	.....	.....	.....
Montreal	Spruce	28.00	29.00	25.00	27.00	30.50	33.00	36.00	.....	.....	.....	.....
	Douglas Fir	47.50	53.00	42.50	44.00	44.00	45.75	51.00	51.00	51.00	43.00	.....
New Orleans	Southern Pine	23.90	25.90	29.00	25.75	26.75	26.00	39.00	.....	.....	45.00	55.00
	Douglas Fir	28.95	31.50	33.90	29.35	32.90	33.95	37.95	.....	.....	.....	.....
New York	Southern Pine	33.00*	34.00*	33.00*	34.00*	34.00*	36.00*	45.00*	.....	.....	70.00*	70.00*
	Douglas Fir	.....	.....	38.00*	37.00*	38.00*	38.00*	38.00*	43.00*	43.00*	.....	.....
Philadelphia	Southern Pine	30.00	31.00	32.00	32.00	33.00	34.00	36.00	.....	.....	36.00	42.00
	Douglas Fir	45.00	45.00	45.00	45.00	45.00	45.00	45.00	42.00	42.00	.....	.....
Pittsburgh	Southern Pine	30.50	31.90	37.65	33.75	36.52	37.50	47.75	.....	.....	57.50	57.50
	Douglas Fir	38.52	39.70	39.70	38.55	39.10	39.38	53.25	53.25	53.25	.....	.....
St. Louis	Southern Pine	27.50*x	28.00*x	29.00*x	27.50*x	28.50*x	29.00*x	48.00*x	.....	.....	.....	.....
	Douglas Fir	.....	.....	.....	.....	.....	.....	.....	54.00*x	54.00*x	71.00	69.00
San Francisco	Douglas Fir	20.00'	20.00'	21.50'	21.50'	22.00'	22.50'	24.50	25.00'	25.00'	.....	.....
Seattle	Douglas Fir	14.00	15.00	14.00	14.00	14.00	14.00	20.00	19.00	19.00	.....	.....

*Delivered. †Spruce. ‡Long-leafed Y.P. §Norway Pine. ^Northern Pine. =Native. 'At ship's tackle. ,Yard prices. ^10% Disc. taken off. x5M ft. or less #S4S. ≡Rgh. *Contractors in Minneapolis and St. Paul get 20% disc. from list.

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$0.70/1.125	$0.40/.90	$0.60/1.25	$0.75/1.50	$0.60/1.00	$0.30/.40	$0.30/.40
Baltimore	1.25	1.10	1.37½	1.25	1.25	.45	.45
Birmingham	1.00	.60/1.00	1.00	1.125	1.00	.30/.40†	.30/.40†
Boston	1.20	.70/1.17½	1.20	.90/1.37½	1.37½	.50/.70	.50/.70
Cincinnati	.80/1.375	.65/1.20	1.25	1.00/1.25	.90/1.375	.45	.45
Chicago	1.50	1.31¼	1.35	1.31¼	1.50	.82½	.82½
Cleveland	1.25	1.12½	1.25	1.125	1.375	.72	.72
Dallas	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.25/.40	.25/.40
Denver	1.10	1.10	1.10	.....	.....	.50	.50
Detroit	1.25	1.00	1.25	.75/.95	1.25	.55/.60	.55/.75
Kansas City	1.32½	1.12½	1.125	1.12½	1.32½	.70	.45/.50
Los Angeles	1.10	1.10	1.25	1.25	1.25	.50	.60
Minneapolis	1.00	.70/.85	1.00	.85	1.00	.40	.45/.50
New Orleans	1.00	.75	1.00	1.00	1.25	.30/.40	.30/.40
New York	1.50	1.40	1.65	1.50/1.65	1.50	.82½	.50/.80
Philadelphia	.35/1.50	.65/1.10	.70/1.375	.90/1.00	1.10/1.37	.35/50	.40/.50
Pittsburgh	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.35/.50	.35/.50
St. Louis	1.50	1.25	1.47	1.35/1.47	1.50	.78½	.35/.78
San Francisco	1.50*	1.10	1.37½	1.12½	1.25*	.62½	.60
Seattle	1.00	1.00	1.25	1.25	1.25	.60	.60
Montreal	1.00	1.00	1.25	1.25	1.25	.60	.60

Skilled Avg: (Bricklayers, Carpenters, Ironworkers) $1.097 Common Avg. $0.5275 *6-hr. Day. †PWA.